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A New Giant *Anolis* From Cuba

By G. K. Noble and W. G. Hassler

RECENTLY we have received two series of giant *Anolis* alive from Cuba. An examination of this material under a variety of temperature and light conditions revealed that in spite of the rapid metachrosis which the lizards were able to undergo, there were actually two species in the series. These have long been confused under the name of *Anolis equestris* Merrem.

The most conspicuous difference between the two forms is the color of the dewlap. In one form this is pink while in the other it is yellow or orange. Although these colors fade considerably in preserved material most of our formalin fixed material still retains this color difference which, as we shall discuss below, is also correlated with differences of scutellation.

Merrem's original description (1820) is brief but he refers his name to a lizard figured by Cuvier (1817) which, to judge from the large scales on the sides of the body, is the pink-throated form. Duméril and Bibron (1837) refer to the throat fan as yellowish or white in their diagnosis but as pink in their detailed description of *equestris*. It is clear from the description of the scales that they had the pink-fanned form before them. Gray (1845) refers to the dewlap as yellow or white, Boulenger (1885) as pink. Later authors have continued to confuse these two forms, although Stejneger (1917) figured the yellow-fanned species under the name of *equestris*. While from Cuvier's plate we may assume that the name *equestris* should be applied to the pink-fanned form, no name seems to be available for the yellow-fanned one. Bell's (1827) description of *Anolius rhodolaemus* fits closely the former species. We may therefore give a new name to the yellow-fanned species which may be known as

Anolis ***luteogularis,*** new species

Diagnosis.—Closely resembling *Anolis equestris* Merrem in size and form but differing in having the scales on the sides of the body ovate and frequently in contact with one another, not squarish and separated from one another by skin and a few granular scales; upper surfaces of the body and tail with smaller scales than in *A. equestris,* from 78 to 90 longitudinal rows of scales around the body at a point immediately caudal to the dewlap, instead of 56 to 69 as in that species; from 38 to 50 rows of scales around the tail at the fifth caudal vertebra, instead of 27 to 35 as in *equestris*. In living specimens the general body color olive green or brownish grey, but never the vivid apple green found in *equestris;* in preserved specimens with the body tone brown or greyish and not greenish blue with the granular skin between the body scales standing out white as in that species; throat fan some tone of yellow and not pink as in live or well preserved *equestris*.

Range.—Apparently restricted to the province of Piños del Rio, Cuba.

Type.—A.M.N.H. No. 46502. Adult male, from San Diego de los Baños, Piños del Rio, Cuba, April 18, 1930. J. A. Weber.

Head large, with sharp canthus rostralis and only a slight depression in the praefrontal and occipital areas; two pairs of enlarged praefrontal scales grading into a series of equally rugose but smaller scales in the frontal region;

supraorbital region covered with a cluster of small plate-like scales; supraorbital semicircles a series of irregular and very rugose scales; interorbital and parietal areas covered with a series of small more tubercular scales; three rows of these between the supraorbital semicircles; six tubercular scales and three to five small ones forming the canthus rostralis on each side; four rows of loreal scales immediately before the eye, the lowest of the series being the largest; one row of large suboculars, the more posterior bearing tubercular ridges; eight supralabials to below the center of the eye; temporals flat; ear opening small and surrounded by small flat scales; back and sides of the body covered with a series of ovate scales which, although partly separated by minutely granular skin, usually make contact with one another where the skin is not stretched; median crest of a single series of small pointed scales extending along the length of the body and tail; in the nuchal region the scales narrow and tend to be recurved; in the tail region these scales increased greatly in length but only slightly in height; ventral scales slightly larger than those on the back, about equal in size to those on the sides of the body, arranged in regular transverse rows; scales on the fore and hind limb smooth, arranged in regular rows, and, as in the case of the scales on the abdomen, with no intervening granular skin; digital expansions well developed, forty-one lamellae under the third and fourth phalanges of the fourth toe; tail strongly compressed; gular appendage very large with distinct rows of small, flat scales on the extended skin, the edge rounded, thickened and scaly; a small cluster of slightly enlarged post-anal scales.

Dark brownish above (in alcohol), the edges of the scales tipped with pale reddish brown; the granular skin between the scales, where visible, dark brown; lips, ear region and some of the canthal tubercles, whitish or cream color, the white extending as a conspicuous pale stripe over the shoulder; ventral surface, white suffused with brown on the edges and the throat, sides of belly and under surface of the tail.

DIMENSIONS.—Tip of snout to vent, 171 mm.; tail (broken and partly regenerated), 126 mm.; greatest width of head, 32 mm.; foreleg from axilla, 64 mm.; hind leg, 102 mm.

VARIATION.—The 46 paratypes in our series (A.M.N.H. 7762, 46134-73, 49046-9, and 57961) differ considerably in color and head rugosity. In some the tubercles along the canthus rostralis are more pronounced than in others but they never reach the extremes of *equestris*. There are 7 to 11 upper labials to a point beneath the center of the eye. The nostril to eye distance includes 20 to 24 scales along the sides of the body and 24 to 28 scales on the sides of the tail. A similar variation occurs in *equestris* but here the counts are 13 to 16 scale rows for the same distance on the tail. There is little sexual dimorphism other than the enlarged postanal scales of males which are often only feebly differentiated.

Many of the paratypes are nearly uniform bluish grey or brown with a few light tubercles on the canthus, a light stripe on the lower jaw and some indication of a light streak over each shoulder. Others are distinctly cross-banded, especially on the tail, with the light streak along jaws and shoulder much more pronounced. These have many of the body scales tipped with a lighter tone.

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AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK CITY.

The Occurrence of Albinos in a Brood of the Common Water Snake, *Natrix sipedon sipedon* (L.)[1]

By WILLIAM M. CLAY

ALTHOUGH albino snakes of several species have been recorded, it seems that the occurrence in captivity of broods containing albinos is somewhat unusual, inasmuch as a reasonable examination of literature has failed to reveal any account of such an incident. Consequently, it may be of interest to report that a specimen of *Natrix sipedon sipedon* (Linné), the common water snake, in the writer's collection gave birth on August 8, 1934, to a litter containing six albinos and seventeen individuals of normal coloration. The female, which was collected May 20, 1934, at Halfmoon Lake in Livingston County, Michigan, by Mr. H. K. Gloyd, is of normal coloration. The other parent is unknown.

The entire absence of dark pigment in the albinos gives these little snakes a striking coloration in marked contrast to that of the normals. The pattern is identical in the two phases (see fig.), but instead of dorsal and lateral spots of dark brown separated by gray-buff, the albinos have pinkish spots with white or cream interspaces. The ground color of the ventral surface is white as in the normals, but the usual blackish crescents on the ventrals and subcaudals are represented in the albinos by pinkish crescents. Their eyes are pink, and their bodies so transparent that when held against a light such internal structures as intestine, lung, gall bladder, and heart are plainly visible.

The account given above describes the ordinary appearance of these snakes when viewed at a distance of one or two feet, but an inspection under a lens reveals the presence of other colors. The description which follows

[1] Contribution from the Zoological Laboratory of the University of Michigan.

is that of one of the specimens and may be taken as fairly typical of the lot, for not a great deal of variation is present. The color names that are capitalized are taken from Ridgway's *Color Standards and Color Nomenclature* (Washington, 1912).

The flesh color of the markings (which correspond to the dark markings in the normals) is due chiefly to their almost complete lack of pigment and to the transparency of their epidermis, so that the color of the underlying tissue is apparent. This varies from Hydrangea Red and Vinaceous to Deep Brownish Vinaceous and Brownish Vinaceous. A small amount of red pigment is present in these areas, however. In the dorsal spots it is in the form of flecks of Apricot Orange, most pronounced on the neck region and first two dorsal bands where it is sufficiently intense to be seen easily by the unaided eye. A small amount of this pigment is present in the lateral spots, where it varies from Light Salmon-Orange to Flame Scarlet, and in the more or less crescent-shaped markings of the gastrosteges and urosteges, as flecks of English Red. The interspaces, both dorsal and lateral, are white to Cream Color with occasional tinges of Pinard Yellow. The lateral interspaces frequently are narrowly margined with Flame Scarlet. The ground color of the gastrosteges and urosteges is white, but contains a small amount of Pinard Yellow, especially in the median line.

Of the head plates, the preoculars, rostral, mental, and chin shields are white. The nasals are Cream Color. The prefrontals are Cinnamon, margined with Cream Color and white, and are semi-transparent in their centers through which the Brownish Vinaceous of the dermis is visible. The frontal and parietals are Brownish Vinaceous (i.e., transparent) and are margined and flecked with Brownish Vinaceous and white. The postoculars are white with small transparent (Dark Vinaceous) areas. The upper labials are white, narrowly margined dorsally and posteriorly with Dark Vinaceous; the lower labials are similar except that the Dark Vinaceous is restricted to their posterior margins.

The iris is Nopal Red washed irregularly with Capucine Orange and Capucine Buff. The pupil is Nopal Red.

It is apparent then that the skin of these albinos possesses at least three types of pigments or coloring agents: a red, a yellow, and a white. The red is distributed as flecks in some of the scales of the dorsal and lateral spots and on portions of the ventral scutes, and varies from Apricot Orange to Flame Scarlet and English Red. The yellow pigment is described as Pinard Yellow and is present in rather small quantities both dorsally and ventrally. The pinkish color of the transparent areas (which correspond to the dark brown and black areas of the normals) is due mainly to blood in the dermis. The white areas are opaque. The normals possess in addition to the above, a black pigment which tends almost completely to obscure the red and yellow except as it may blend with them to produce brown.

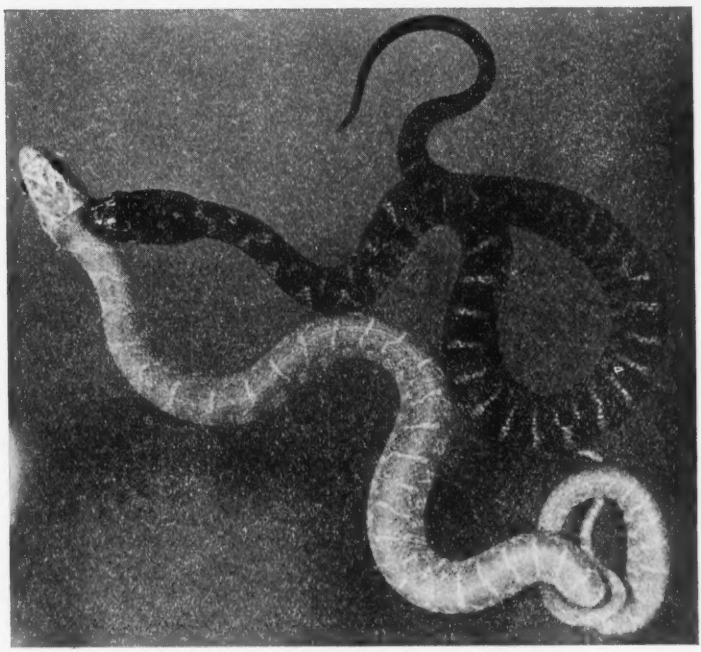
Both sexes are represented in each color phase, the normals consisting of 11 males and 6 females and the albinos of 2 males and 4 females.

Apparently the albinos are not significantly different in size or scutellation from the normals in the same brood, or from other specimens of *sipedon* from the same region.

TABLE I. VARIATION IN SIZE AND SCUTELLATION IN THIS BROOD

	Size[2] (in millimeters)		No. of Ventrals		No. of Caudals		No. of specimens
	Extremes	Average	Extremes	Average	Extremes	Average	
Males							
Normals	212–245	223.5	141–150	143.5	68–74	72.1	11
Albinos	225–228	226.5	143–145	144.0	73–76	74.5	2
Females							
Normals	215–223	218.0	140–141	140.7	59–62	61.2	6
Albinos	206–225	213.8	138–144	140.0	59–62	61.3	4

No differences between the two phases in habits or behavior have been noticed, although no especial comparisons of this sort have been attempted.



A normal and an albino juvenile *Natrix s. sipedon*.

The brood has been kept in a cage indoors in moderate light and the majority of the individuals usually are concealed in the shavings on the floor, but the albinos seem to spend about as much time in the light as do the others. All of both phases were reluctant to feed at first, but after numerous forced feedings on small pieces of fresh fish, most of them became eager to eat.

Several instances of albinism in snakes have been reported, both in America and in Europe. I have read several of these papers, but it is probable

[2] These measurements were taken on October 10, 1934.

that I have overlooked others, especially those whose titles make no reference to this subject. Perhaps it is significant, however, that in none of the snakes described as albinos were all of the pigments lacking. Always a pattern of some sort was present. In other words, I have found no account of albinism in snakes complete for all colors. In this connection it may be pointed out that if only one of the lesser pigments were lacking, such as the yellow or even the red, in *Natrix s. sipedon,* the individual so characterized scarcely would be distinguishable from one having all the colors and certainly would not be considered an albino. Yet it would seem that this phenomenon would not differ in principle from albinism.

Likewise it is of interest to note that none of the literature examined reveals any other instance of a brood containing albinos. If albinism in snakes is hereditary, the ratio of the frequency of the two phases in a brood is of significance. In the brood under discussion it will be noted that this ratio is essentially 3:1 (17 normals to 6 albinos). The most logical interpretation of this is that albinism in snakes, as in mammals, is a recessive character, and that the presence or absence of the dark pigment (the only one lacking in these albinos) is due to a single gene. According to this explanation, albinos could be produced only by parents each of which contained in its germplasm at least one gene for albinism, and a 3:1 ratio of normals to albinos is theoretically that to be obtained from two heterozygotes, although actually it could result from the mating of a heterozygote with a homozygous recessive (theoretically the latter would give a 1:1 ratio). Since the female parent appears normal, it follows that she must be a heterozygote, and most likely the male parent is similar, not only for the reason given above but also because of the seeming rarity of albinos in nature. Of the young normals, about two-thirds should be heterozygotes and the remainder homozygous dominants. All the albinos obviously would be homozygous recessives.

Storer (COPEIA, 35, 1916: 74–76) described an albino western gopher snake, *Pituophis catenifer* (Blainville), which bore certain abnormalities in its head scutes, and he suggested that the latter may have resulted from the same cause as the albinism. Seven of the snakes in the present brood also possess an irregularity in that one or more subcaudals are single instead of paired. This condition is represented in both sexes in both color phases and exhibits considerable variation not only in the number of undivided scutes but also in their location. Thus in one of the albinos the first three urosteges (counting caudad from the anus) are single, and in another the 24th, 29th, and 58th. In one of the normals all the subcaudals are paired save the 3rd, but in another the 6th to 17th and 48th to 50th are single. However, I have observed this abnormality at other times in occasional specimens of several species of *Natrix,* a fact which suggests that it is not related to albinism. Its occurrence in almost one-third of the snakes in this brood may be evidence that its cause is hereditary, nevertheless.

ZOÖLOGICAL LABORATORY, UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN.

Notes on the Western Spotted Frog, *Rana pretiosa pretiosa*

By Arthur Svihla

THE western spotted frog is perhaps one of the most common and widely distributed frogs in Washington, yet little seems to be known concerning its life history. It is found throughout the state according to Slevin (1928) and occurs on both sides of the Cascade Range. Storer (1925) referred specimens from Walla Walla and the Blue Mountains, Washington, to the subspecies *luteiventris* rather than *pretiosa*. Slevin did not recognize *luteiventris* as a separate subspecies but placed it in synonymy with *pretiosa*. This conclusion was evidently based on the work of Van Denburgh and Slevin (1915), who were unable to find sufficient differentiation between the adults of *R. pretiosa pretiosa* from Mount Rainier, Washington, and *R. p. luteiventris* from Utah for separation. Further work on the interrelations and distribution of these subspecies is obviously needed. Personally, I am not familiar with *luteiventris*, but I have found a distinct difference in the mouth parts of *pretiosa* tadpoles and those pictured for *luteiventris* tadpoles. Since the eggs of *luteiventris* have not yet been described there may be still further differences between the two.

In Washington the spotted frog seems to be more abundant west of the Cascades than on the eastern side. This is due no doubt to the greater humidity and number of permanent streams on the west side, for this frog is rarely found far from water. As Dickerson (1906) and Blanchard (1921) have both noted, it is a pond dwelling form and very aquatic in habits.

In eastern Washington, particularly in the vicinity of Pullman, the spotted frog is found along the Palouse River and in such roadside pools as are formed during the construction of the highways. These roadside pools are well filled with water in the spring, and here the spotted frogs congregate for the breeding season. Even at this time of the year they are not abundant and are never found in such large numbers as the tree frog *Hyla regilla*. This corroborates Blanchard's observations on the spotted frog in Stevens County, Washington.

In the vicinity of Pullman the first amphibian to appear in the spring is the long-toed salamander, *Ambystoma macrodactylum*, which may be found, according to the season, late in January or early in February. The spotted frog emerges a few weeks later, usually late February or early March. By the middle of March and early April the breeding season is in full swing, and mating pairs as well as eggs in all stages of development can be found. The breeding season extends into the middle of April. After this time it is usually impossible to find eggs or even adult frogs.

Soon after the spotted frog makes its appearance in the spring, mating commences, and the ponds are resonant with their deep bass calls. Their short bass notes are easily distinguishable from the almost constant high

shrill song of the tree frog and can be heard for at least a quarter of a mile. On several occasions pairs of spotted frogs brought into the laboratory while in amplexus were observed to drop to the bottom of the aquarium in which they were kept and there emit their call. Although the sound was greatly dampened by the water, the note could still be heard distinctly for some distance within the room. When emitting their call notes only a slight tremor at the sides of the throat is visible. The vocal sacs are evidently poorly developed for they do not protrude as they do in other ranas.

The males are noticeably smaller than the females. Amplexus in this species is pectoral, the male passing his arms under the armpits of the female and placing the hands on the sides of her chest, bringing into play the nuptial excrescences of the first digits. Several males have been observed to clasp a single female and on other occasions males have been seen to clasp spent females as well as the other males. Usually these abnormal claspings are of short duration. Amplexus may last for several days. In one case in the laboratory a female was seen in embrace for four days before ovulation took place.

Dickerson (1906), through information furnished by Prof. Illingsworth, was the first to describe the egg masses and places of deposition of this frog. In the vicinity of Pullman the egg masses are deposited in shallow water among the grasses at the edges of ponds, although the egg masses themselves are not attached to blades. Usually they are found in such shallow water that the top row of eggs is exposed above the water and the entire mass assumes a flattened shape. The egg masses vary somewhat in size but are large, sometimes measuring 200 mm. by 150 mm. in area, and usually contain from a pint to a quart or more of eggs. Each egg, however, is individual and distinct though held in the mass by the neighboring viscous jelly coats so that it is very difficult to separate an egg from its neighbor. Two egg masses were measured and the number of eggs estimated. One mass contained 1500 cc. and the other 1100 cc. Since each egg measures more than 1 cc. the number of eggs in these masses would approximate 1500 and 1100 respectively.

Fig. 1. *Rana pretiosa* egg, x 2½.

Each egg including its jelly coats measures from 10 to 15 mm. in diameter, the egg proper being only from 2 to 2.8 mm. in diameter. There are two jelly coats present, an inner one measuring from 5 to 6 mm. and an outer one varying from 10 to 15 mm. (Fig. 1). The inner coat is rather hard to see but is apparent when viewed obliquely or when the egg becomes infected with a fungus or bacterial growth, which is usually found in the inner coat. The newly deposited egg is black in color at the animal pole and creamy white at the vegetal pole. The vegetal pole varies in size from a mere point to half of the egg. The vitelline capsule closely circumscribes the egg.

The eggs usually hatch in a short time. One egg mass in the laboratory hatched in four days. At first the young larvae remain within the vitelline capsule, but as they grow larger and older they push their way through

the jelly and emerge on the outside. Here they cling to the outer jelly coat for a day or so. At the time of hatching the young tadpoles are sooty brown in color and measure from 7.3 to 8.7 mm. in length. The adhesive discs, dextral anus, and external gills are apparent at this time.

The tadpoles grow very rapidly for in about thirty days the hind limb buds appear and the total length has increased from about 8 mm. to 36 mm. At this time the head and body are 15 mm. in length and the tail 20 mm. The depth of the body is about 10 mm. and the greatest width 7 mm. The tail is 1.4 to 1.6 times the combined length of the head and body. The eyes are dorsal, well up on the head, and rather close together, the interorbital distance being about 2 mm. The external nares are situated almost midway between the eyes and the tip of the snout but are slightly closer to the eyes. The interorbital distance is contained 7.5 times in the length of the head and body. The anus is dextral and spiraculum sinistral, being directed upward and backward as in other Ranidae. The greatest depth of the tail (over fins) is contained 2.5 times in the length, while the greatest depth of the muscular portion is contained approximately 7 times in the length of the tail.

Fig. 2. Mouthparts of *Rana pretiosa* tadpoles.

At the age of the appearance of the hind limb buds the mouth parts appear as follows: on the upper lip there is but a single row of labial teeth which is divided medially into two very short sets situated near the ends of the upper jaws. On the lower labium there are three long rows of teeth, the second or middle row the longest, the first and third about equal in length. A single row of labial cirri extends along the sides and bottom of the lips (Fig. 2).

The mouth parts of *R. p. pretiosa* tadpoles differ from those of *R. p. luteiventris*. In *pretiosa* there are four rows of labial teeth, one very short upper row and three lower rows. In *luteiventris* there are five rows, two long upper rows and three lower, as figured by Thompson (1913). The first lower row in *luteiventris* is longer than the analogous one in *pretiosa*.

By the middle of June the tadpoles metamorphose into frogs. At this time the newly transformed frogs are 60 mm. in total length with a head and body length of 26 mm. There is no indication of the reddish coloration on the underside of the thighs and abdomen of these young frogs.

Since spotted frogs of two very divergent sizes, one about half the size of the other, can be found during the springtime, it seems reasonable to conclude that at least two years are required for this frog to reach mature size.

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STATE COLLEGE, PULLMAN, WASHINGTON.

Notes on Fishes in the Zoological Museum of Stanford University. II. Two New Genera and Species of Japanese Sharks and a Japanese Species of *Narcetes*

By ALBERT W. C. T. HERRE

SQUALIDAE

Phaenopogon, new genus

FROM the anterior marginal flap of each large and nearly transverse nostril a stout elongate barbel extends beyond the mouth. The base of this barbel conceals the wide, elongate and inwardly curved flap of the posterior margin of the nostril.

The two dorsal fins are each preceded by a long strong spine, grooved posteriorly but not marginally. The second dorsal spine is higher than the fin proper. The first dorsal is near the pectoral, the second dorsal behind the ventrals.

The laterally compressed body is greatly elevated, with depressed head and short, bluntly rounded snout. The trunk is longer than the tail. The eyes are lateral, elongate; the large spiracles lie above and behind the eyes. The wide mouth is nearly horizontal, with a deep groove, and labial folds at each angle. The teeth are almost alike in both jaws, nearly horizontal so that the inner margin of a tooth forms its cutting edge. The caudal has a produced subcaudal lobe and is without a notch below the posterior lobe. The scales are tricuspid with a very stout middle keel.

This is another strange deep sea shark from the prolific waters of Japan. *Phaenopogon* is from *Phaeno* (φαίνω), "I display," and *pogon* (πωγων), "beard."

The type is *Phaenopogon barbulifer,* new species.

Phaenopogon barbulifer, new species

Figure 1

The depressed head, measured to the first gill slit, is contained 4.6 times, the depth 3.46 times, the caudal 3.3 times, in the length. The elongate eye measures 4 times in the head, and nearly twice in the interorbital, which is contained 2.07 times in the head. The distance from the tip of the snout to the mouth is contained twice in the head, and from the snout tip to the nostril 4.6 times; the distance between the nostrils 2.66 times, the width of the mouth 2.5 times.

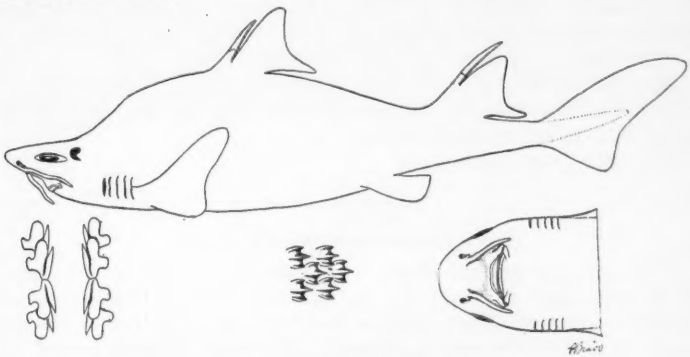


Fig. 1. *Phaenopogon barbulifer.*

Lateral view of the holotype, with detailed drawings of the upper and lower teeth, scales, and lower side of head.

The very deep trunk is laterally compressed, a little over half the length to the caudal base. The predorsal region is very strongly elevated. There is a groove between the dorsals and between the second dorsal and caudal. The blunt snout is broadly rounded. The nostrils are much nearer the tip of the snout than the mouth; the anterior margin of the nostril bears a wide flap which is produced into a stout and much elongated barbel extending beyond the mouth; the length of this barbel enters the head 2.3 times; at the outer base of the barbel is a small pointed flap; the posterior margin of the nostril is produced into an elongate flap which curves over into the nostril and is further concealed by the base of the barbel. The eye is much nearer the tip of the snout than the first gill opening. The large spiracle (drawn too low in the figure) is close behind and mostly above the eye. The horizontal mouth has a deep groove beyond its angle; each lip has a large labial fold at the angle. The cutting edges of the teeth are nearly horizontal; the teeth, nearly alike in the two jaws, number 26 in the upper and 22 in the lower jaw. The width of the first gill-opening is contained twice in the eye or 8 times in the head; that of the last gill-slit, 1.36 times in the eye or 5.45 times in the head.

The first dorsal base is contained 1.76 times, its height 1.6 times, the height of the first dorsal spine 1.875 times, and the distance from the origin of the fin to its posterior tip 1.11 times, in the head; the hind margin is

concave, the hind angle produced. The base of the second dorsal equals its height, and enters the head 1.64 times; the much higher spine, 1.36 times; the distance from the second dorsal origin to its produced posterior angle is almost equal to the head; the hind margin is concave. The pectoral is somewhat triangular; its anterior or outer margin is equal to the head; its inner margin is contained twice, its breadth 1.2 times in the head; its hind margin is concave. The subcaudal lobe is large, subtriangular; the tip of the caudal is blunt; its greatest height measures 1.75 times in its own length. The ventral origin is nearer the second dorsal than the first; the length of the ventral fin is contained 1.71 times, its breadth 2.8 times in the head. There is a small dermal ridge low down on each side of the caudal peduncle.

The scales are tricuspid, with a strong middle ridge.

The color in alcohol is brownish mouse-color, slightly paler below.

Described from the type and only specimen, 555 mm. long, dredged from Misaki Bay, Japan, by Alan Owston.

Barbulifer, barbel bearing.

SCYMNORHINIDAE

Genus ***Pseudoscymnus***, new genus

The body is elongate, fusiform, with a groove on each side from above the pectoral origin to above the ventral. The head is rather small and somewhat depressed, flattened above, with very short and broadly rounded snout; the nostrils are very far forward. The mouth is gently arched with a very long labial fold concealing each angle; the teeth are unlike in the two jaws, although in 18 rows both above and below: the upper teeth are slender and pointed, with several rows functioning; the lower teeth are broad, with a single triangular serrate cusp on a broad and long base, slightly oblique, with but one row visible. The large elongate eyes have no nictitating membrane. The large transverse spiracles are on top of the head, well behind the eyes. The narrow gill-openings are in front of the pectoral.

All the fins are small. The dorsals are without trace of spines; the first dorsal lies between the pectorals and ventrals, the origin of the second dorsal over the posterior part of the ventrals.

The scales on the lower side of the snout are conspicuously larger than elsewhere, simple, smooth, triangular, imbricate. Elsewhere the scales are minute, closely appressed, widely spaced, more or less keeled, and trifid with a long central point and with the two lateral points at right angles to the central one.

This genus differs from the rest of the family in its serrate lower teeth, the position and character of its fins, and in having two kinds of scales.

The type is *Pseudoscymnus boshuensis*, new species.

Pseudoscymnus ***boshuensis***, new species

Figure 2

The depth of the elongate body at the pectoral base is contained 8 times in the length over all. As the abdomen is shrunken it is not possible to measure its greatest depth accurately, but this is contained approximately 6.6

times; the head measured to the first gill opening 4.16 times, its greatest breadth 6.74 times, and the trunk 1.83 times in the total length including caudal. The length of the broad blunt snout measured from the mouth is contained 2.7 times in the head, and from the eye 4.5 times; the large elongate eye 4.76 times; the flat interorbital 2.9 times; the distance from the eye to the first gill-opening a little more than 1.7 times, in the head. The nostrils are very far forward; the lower or innermost is concealed by a scaly flap. The distance between the outer margins of the upper nostrils measures 3.68 times, that between their inner margins 4.76 times in the head. The distance from the eye to the lunate transverse spiracle is almost equal to the eye. The length of the spiracle is contained 2.42 times in the eye; the distance between the spiracles 3.52 times in the head. The gill-openings are narrow; the width of the first measures 10.8 times, that of the last 8.1 times in the head.

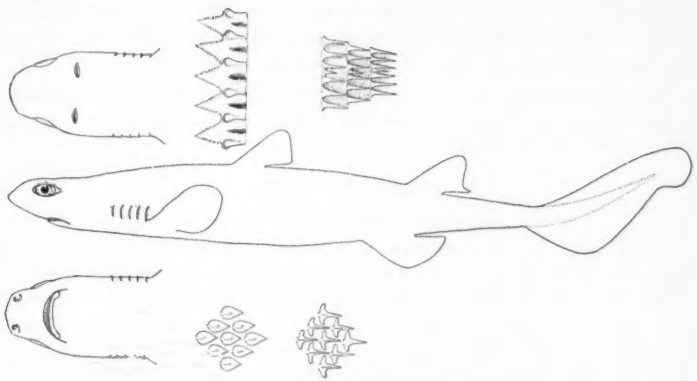


Fig. 2. *Pseudoscymnus boshuensis.*

Lateral view of the holotype, with detailed drawings as follows: above, from left to right, upper view of head, teeth of lower jaw, and teeth of upper jaw; below, from left to right, lower view of head, scales from lower surface of snout, scales from body.

The width of the gently arched mouth is contained 3.375 times in the head; the upper lip is extended laterally into a prolonged skinny flap reaching far below the mouth and concealing its outer fourth. The teeth are in 18 rows above and below; the upper teeth are simple, awl-shaped, with 4 rows of different sizes in use; only one row is visible in the lower jaw; the serrate cusps of the lower teeth are slightly oblique, with a more or less evident basal notch on the outer side.

The small first dorsal is well behind the pectoral; the distance from its origin to the snout is contained 2.13 times in the total length; the base of the first dorsal 4 times in the head; its height is almost twice its base and its breadth is a little more than its base; the hind margin is truncate. The distance from the insertion of the first dorsal to the origin of the second dorsal measures 3.48 times in the total length. The second dorsal is larger than the first; the middle of its base is over the posterior end of the ventral base; its basal length is contained 3.11 times in the head; the height of the

second dorsal 1.73 times its own base and 1.8 times in the head; its breadth is a little less than its base; the posterior margin is slightly concave. The origin of the subcaudal is much farther forward than the origin of the caudal above; the caudal is contained 3.12 times in the total length, but including the subcaudal 2.8 times; its extreme breadth is contained 2.4 times in its greatest length; a wide shallow notch separates the terminal portion. The distance from the snout tip to the pectoral origin is contained 3.37 times in the total length. The pectoral is a little broader than long; its breadth measures 2.7 times in the head; when appressed it does not reach to below the first dorsal origin. The short ventrals extend very little beyond the vertical from the second dorsal base; the ventral base is contained 2.25 times, its breadth 3.24 times in the head.

The scales are as given for the genus, smooth when stroked toward the caudal but very rough and spinescent when rubbed toward the head.

The color in alcohol is blackish brown. The dorsals, pectorals, ventrals and subcaudal are black with pale margins. The peculiar scales on the lower side of the snout glisten with a brilliant metallic luster.

Described from the type and only specimen, a female 337 mm. long, taken by Alan Owston at Boshu, Sagami Bay, Japan. It was evidently caught by hook and line, as the mouth was torn on one side.

ALEPOCEPHALIDAE

Narcetes ***wonderi,*** new species

Dorsal 15; anal 14; pectoral 8; ventral 8; there are 60 scales in the lateral line, about 20 in a transverse series, and about 46 predorsal scales.

The depth of the elongate, laterally compressed, fusiform body is contained 5.17 times, the large head 3.5 times, the forked caudal 5.78 times, in the standard length. The body is deepest across the pectorals. The dorsal profile is nearly horizontal over most of its length, sloping gently on the head and caudal peduncle; the ventral profile is a continuous gently convex curve. The breadth of the head is contained 2.48 times in its own length; its depth 1.77 times. The prominent snout, including the lower jaw, is boldly curved from above the nostrils; viewed from above, it is acutely rounded; its length measures 2.88 times in the head. The eye, lateral and high up, is contained 7.75 times in the head, nearly 2.7 times in the snout, and 2.125 times in the broad and nearly flat interorbital, which measures 3.64 times in the head. The mouth is very large, its true length is contained 2.17 times in the head; its angle lies below the hind margin of the eye. The maxillary extends far beyond the eye, and with its broadly rounded supplemental bone entirely conceals the corner of the mouth; its length, 1.77 times in the head.

The teeth are small, slender, needle-like, straight or hooked, in several rows on the premaxillaries, maxillaries, and mandible; so easily broken that many are missing; there are 2 or 3 rows on the palatines, and two small groups on the divided vomer. The nostrils are large, conspicuous, in front of the upper part of the eye; the rear one is pear-shaped. Gill-rakers 6 + 14, the last two much smaller than the others; the longer ones, 1.6 times in the eye. Pseudobranchiae present.

All the fins are small. The vertical fins are low. The origin of the dorsal

is far back; its distance to the tip of the snout, 1.54 times in the length; the base of the dorsal, 2.21 times, the height of its fifth ray, 2.7 times in the head. The origin of the anal is beneath the base of the penultimate dorsal ray; base of anal 2.7 times, the height of its fourth ray 3.57 times in the head. The origin of the ventral is midway between the pupil and the caudal base; this fin extends to beneath the base of the third dorsal ray, and is contained 3.1 times in the head; the narrow pectoral, 3 times.

The head is entirely naked. The rest of the body is covered with large, elongate, narrow, imbricate, cycloid, deciduous scales; those on the caudal peduncle are smaller than elsewhere and still smaller scales extend on the caudal for nearly half its length.

The head is black. The rest of the fish and the dorsal and caudal are blackish brown; the other fins black. The inside of the mouth and gill covers is also deep black.

Here described from the type and only specimen, 445 mm. long, caudal not included. It was taken by Alan Owston from Sagami Sea, Japan.

Named for Mr. Frank Wonder, of the Field Museum of Natural History, efficient collector of mammals and fishes.

NATURAL HISTORY MUSEUM, STANFORD UNIVERSITY, CALIFORNIA.

A Review of the Cods of the Northeastern Pacific With Comparative Notes on Related Species

By LEONARD P. SCHULTZ and ARTHUR D. WELANDER

THIS study is based on material from Japan, Alaska to California, Europe, and Greenland, made available to us through the kindness of Dr. Carl L. Hubbs, Curator of Fishes, University of Michigan, in which institution most of the work was done. Additional data were obtained from specimens taken in Alaska, Europe, and Puget Sound, deposited in the collection of fishes of the School of Fisheries, University of Washington.

The problem of the correct nomenclature of the species of cods inhabiting the northeastern Pacific region, and of their relationships to the cods of other regions, has caused various authors much concern for more than a century and a quarter. Not until the last decade has a really serious attempt been made to solve this problem. We have considered especially four main questions: (1) The differences between the common cod of the north Atlantic and of the north Pacific oceans; in other words, the validity of *Gadus macrocephalus;* (2) the valid specific name for the species of *Eleginus* occurring in Alaska; (3) the differences between the latter form and *Microgadus proximus;* (4) the geographical variation and the grounds for the subspecific division of *Theragra chalcogramma.*

Analysis of the characters of the various genera and species of cod in the northeastern Pacific Ocean

1a.—Dorsal fins 3; anal fins 2.

2a.—Lower jaw included (the upper jaw extends beyond tip of lower jaw); barbel present at tip of chin, always longer than one-half diameter of pupil; gill-rakers on first gill arch 16 to 29; caudal fin slightly concave or truncate.

3a.—Barbel equal to three-fourths as long (in young) as, or longer than, the diameter of the eye.[1]

4a.—Transverse processes of vertebrae not swollen at tips; vertebrae 51 to 57; first dorsal with somewhat rounded posterior margin; lateral line breaking up into separate tubes under middle of second dorsal; arch of lateral line evenly curved; air-bladder with a pair of short horns anteriorly, extending toward the mid-line, with a rudimentary tip curved outward.

5a.—Depressed first dorsal scarcely reaching origin of second dorsal; length of depressed first dorsal less than the distance from eye to origin of that fin; peritoneum blackish; anus located below or a little behind origin of second dorsal fin; lateral line a little lighter in color than body; all vertical fins with their margins whitish, the proximal portion of the fins pigmented. . . . . *Gadus macrocephalus* Tilesius

3b.—Barbel equal to or shorter, rarely somewhat longer than the diameter of the pupil.[1]

4b.—Transverse processes of vertebrae swollen into hollow balls at tips; vertebrae 60 to 62; first dorsal with rounded posterior margin; lateral line breaking up into separate tubes under origin of second dorsal; arch of lateral line flat-topped and curving abruptly downward to the axis of the body below the first third of the second dorsal; air-bladder with a pair of short horns anteriorly, extending toward the mid-line, with an arm curved forward without a rudimentary curved tip.

5b.—Depressed first dorsal scarcely reaching origin of second dorsal; length of depressed first dorsal contained in distance from eye to origin of that fin 1.5 times; peritoneum silvery, with small scattered black dots; anus located below the posterior edge of first dorsal fin base or under interspace between first and second dorsal fins; lateral line of about same color as body. . . . . *Eleginus gracilis* Tilesius

4c.—Transverse process of vertebrae flattened and not swollen at tips; vertebrae 55 to 58; first dorsal with truncate posterior margin; lateral line breaking up into separate tubes below the posterior fourth of the third dorsal fin; arch in lateral line evenly curved and reaching the axis of the body no farther forward than below the posterior tip of second dorsal; air-bladder with a pair of short horns anteriorly, extending toward the mid-line, with an arm curved forward without a rudimentary tip.

5c.—Depressed first dorsal extending for about one-fifth its length beyond the origin of second dorsal; length of depressed first dorsal about equal to distance from eye to origin of that fin; peritoneum whitish, and finely stippled with black; anus located under the posterior fourth of the first dorsal fin base; lateral line usually a little darker in color than the body. . . . . *Microgadus proximus* (Girard)

[1] We find that this character holds when the fish are as small as 40 mm. and even on some still smaller specimens.

2b.—Lower jaw equal to or longer than the upper; barbel at tip of the chin absent or very small, always less than one-half diameter of pupil; gill-rakers on first gill arch more than 30; caudal fin distinctly forked or concave behind.

6a.—Teeth in upper jaw in a villiform band, the outer ones somewhat enlarged and rather wide-set; subopercle and postclavicle swollen and ivory-like in adults (but normal in young); distance from posterior tip of second dorsal fin to origin of third dorsal two-thirds as long as, to a little longer than eye; caudal fin slightly concave; gill rakers 5 to 7 above the angle on the first gill arch; eye 3.3 to 4.7 in head, larger than in any other cod in this region. . . . . *Theragra chalcogramma* (Pallas)

6b.—Teeth in upper jaw slender, wide-set, in one or two series; subopercle and postclavicle normal (similar to the other opercular bones), not swollen and ivory-like in adults; distance from posterior tip of second dorsal to insertion of third dorsal one-half diameter of eye; caudal fin forked; gill rakers 9 to 11 above the angle on first arch. . . . . *Boreogadus saida* (Lepechin)

The Validity of Gadus macrocephalus Tilesius

The distinctness of the Pacific cod from the Atlantic cod has been questioned by numerous ichthyologists, but so far no one has carefuly compared them. T. H. Bean (1887: 198-199) thought the problem was solved when he wrote:

> The cod fishery of Alaska has nearly ended its second decade, yet it was not until the summer of 1880 that we knew positively what species of *Gadus* is the object of the fishery. Most writers have referred to it under the name of *Gadus macrocephalus*, which was bestowed by Tilesius upon the Kamtchatkan cod, the figure of which suggests that it was based upon a deformed individual. Cope in 1873, described the young of the common Alaska cod as a new species, *Gadus auratus*, from specimens collected by Prof. George Davidson, of the U. S. Coast Survey, at Unalaska. Steindachner, in the Proceedings (Sitzungsberichte) of the Vienna Academy, LXI, I, 1870, adopts the name *G. macrocephalus* for a large cod taken in De Castries Bay (Mouth of Amur River), Siberia. In this example the length of the head is contained exactly three times in the total length to the extreme end of the pointed caudal peduncle. The same proportion may, however, be found in any place where large numbers of *Gadus morrhua* are taken, and it can readily be proven to be only a matter of individual variation. The U. S. Commissioner of Fish and Fisheries, Prof. Spencer F. Baird, with a view to investigating the fisheries and fish of Alaska, sent the writer to that Territory to collect specimens and statistics during the summer of 1880. In this way an opportunity was gained for comparing the Alaskan cod directly with that of New England and of Europe, and for determining beyond a doubt that the commercial cod of both oceans is the *Gadus morrhua* of Linnaeus. I have not seen fresh specimens from the Okhotsk, but there is no probability that it is different from the Alaskan. It is a matter of daily experience to find long-headed and short-headed cod in the same school off the New England coast or wherever the species occurs, as the length of the head is one of the most variable characters. I have just read in the Zoological Record for 1879 (Vol. XVI, published in 1881) the following sentence: "Day records and notices a fish captured at the mouth of the Thames, and referred to *Gadus macrocephalus* Tilesius, probably Yarrell's 'Lord Fish,' and considered to be distinct from *G. vulgaris*." This agrees with my own idea of the *macrocephalus* form of cod. You can find it in almost any large school of the common species. . . . . .

Jordan and Evermann (1898: 2542) stated:

> In external respects we recognize no distinction between this species and the common eastern codfish, except that the head seems larger. . . . . Concerning this species Dr.

Gilbert observes: It has been frequently pointed out, and is well known to fishermen that the Pacific codfish has a smaller air bladder or sound than the Atlantic cod. Pending an examination of this question, which we are not now in a position to make, we propose to recognize the Pacific fish as a distinct species.

Since these ideas have been accepted too generally without any critical investigation, it is common to find such statements as the following, quoted from Vladykov (1933: 27-28):

The Pacific cod is generally considered as a separate species *(G. macrocephalus)*. In reality there is no essential difference between the Atlantic *(G. callarias)* and the Pacific *(G. macrocephalus)* cod. Doubtless both forms should be considered as one species *(G. callarias.)* Jordan in one of his papers (1916) [Jordan, D. S., A manual of the vertebrate animals of the northern United States, Fishes. 6, 1916: 12-173] expresses the same opinion.

Bigelow and Welsh (1925: 411) stated:

The North Pacific cod, with smaller air bladder *(G. macrocephalus)*, can not be separated from the Atlantic cod by external appearance.

John N. Cobb in his "Pacific Cod Fisheries" (1927: 385-387) gave the problem some attention. He quoted from a letter written by Dr. W. C. Kendall on January 22, 1915, as follows:

The air bladder of the big Pacific cod (the weight of this was about 30 pounds and its total length about 39 inches), after removal, measured 13 inches in length, with no perceptible horns excepting slight projections, but it had a very large pouch on each side of the anterior end.

The air bladder of the big Atlantic cod (of a weight of 34¼ pounds and a length of 43½ inches) was of the same length approximately, pouches small, but the horns, which could not be fully straightened out, measured each 10 inches in length. In natural position in the fish they are coiled up.

The small Pacific cod (8 or (9?) pounds and 28⅜ inches long) was in such bad condition that the air bladder could not be removed intact, but the one horn that could be found was only 1 inch in length.

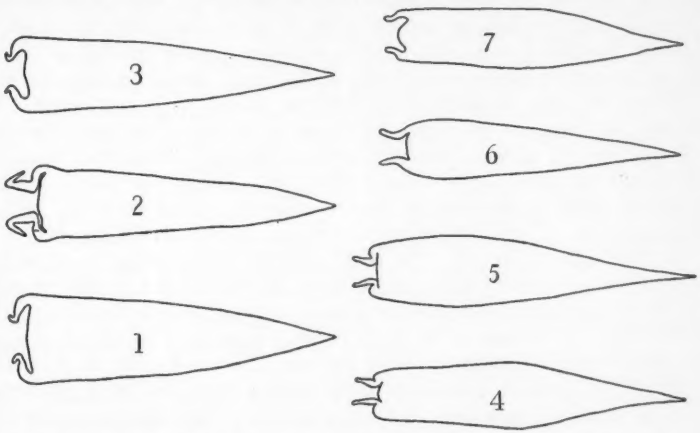
The other Atlantic cod (weights and lengths about the same) had air bladders and horns, as follows: Length 9¼, horns 2½; length 10½, horns 3¼ and 3½; length 10 inches, horns 7 and 5½ inches.

Our studies show that it is not the size of the head nor the size of the air bladder which are useful for the separation of the common Atlantic cod from the common Pacific cod, but the following characters: (1) The length and amount of coiling of the two anterolateral horns of the air-bladder; (2) the color of the peritoneum; (3) the length of the depressed first dorsal; (4) the color around the margins of the dorsal fins and the caudal fin, and (5) the length of the barbel. In general we find that the Pacific codfish, *Gadus macrocephalus*, is more nearly like the Greenland cod, *Gadus ogac*, than like the Atlantic cod, *Gadus morhua*.[2] *G. ogac* has been compared with *G. morhua* by Dresel (1884: 245-247), who has shown the two forms to be well defined and distinct. To his list of six differences we add the color of the peritoneum, leaden-silvery in *morhua* and black in *ogac*. Vladykov (1933: 29, Table 7) gave additional differences between *morhua* and *ogac*, respectively, as follows:

Coloration of body, brownish with distinct round spots; dark without distinct spots. Color of lateral line, white; dark. Interorbital length in % of eye diameter 60.0–76.0; 129.0–142.0. Form of caudal fin, slightly emarginate; truncate or slightly rounded.

[2] We find the original spelling to be *"morhua"* not *morrhua* as used by recent authors.

1. *The air bladder.* An examination of the air-bladder in numerous specimens of *Gadus macrocephalus*, *G. morhua* and *G. ogac*, indicates conclusively that little reliance can be placed on its relative size for the separation of any of these species. The size is too variable. Some of the Pacific cods have air-bladders as large or larger than those found in the Atlantic cod of



Figs. 1 to 7. Diagrammatic outlines of the air bladders of various species of cod.

Fig. 1. *Gadus macrocephalus*, Sitkalidak Straits, Alaska; standard length 689 mm.; total length of air bladder 259 mm.

Fig. 2. *Gadus morhua*, off Massachusetts: standard length 509 mm.; total length of air bladder 187 mm.

Fig. 3. *Gadus ogac*, near Holstenborg, Greenland: standard length 429 mm.; total length of air bladder 187 mm.

Fig. 4. *Eleginus gracilis*, Sitkalidak Straits, Alaska: standard length 215 mm.; total length of air bladder 95 mm.

Fig. 5. *Microgadus proximus*, near the Farallon Islands, California: standard length 219 mm.; total length of air bladder 99 mm.

Fig. 6. *Microgadus tomcod*, Woods Hole, Massachusetts: standard length 91 mm.; total length of air bladder 43 mm.

Fig. 7. *Theragra chalcogramma*, Sawmill Bay, Alaska: standard length 237 mm.; total length of air bladder 84 mm.

the same size, while in others the reverse was true. The length of the two horns at the anterior end of the air bladder in *macrocephalus* and *morhua* varies considerably, as pointed out by Kendall (in Cobb, 1927), but the horn in *macrocephalus* is short, stout, and somewhat firm and non-flexible, extending toward the mid-line, with the rudimentary tip curved outward (Fig. 1), while in *morhua* the horn is long, slender and flexible, at first extending toward the mid-line, then curving abruptly forward, finally bent backward and outward in an arm one-half to three-fourths the length of the preceding arm (Fig. 2). Apparently the anterolateral horns of the air-bladder become more highly developed with age in the larger *morhua*, because in the young of that species, about six inches in length, the horns differ but little from those of Pacific cod 18 to 24 inches in length. We found no striking differences between the horns of the air-bladder in *macrocephalus* and *ogac* (Fig. 3). The shape of the horns in other cods is shown in Figs. 4, 5, 6 and 7.

2. *The color of the peritoneum.* The peritoneum of *morhua* is leaden-silvery in color, stippled with black, while in *macrocephalus* and *ogac* it is brownish black to jet black.

3. *The length of the depressed first dorsal* (measured from the origin of the fin to its most posterior tip when depressed against the back). In *morhua* and *ogac* the first dorsal extends considerably behind the origin of the second dorsal fin, and overlaps the second dorsal fin about one-fourth to one-sixth (usually one-fifth) of its own length. In *macrocephalus* the first dorsal is shorter, scarcely reaching to the origin of the second dorsal fin, only rarely a little beyond, never as much as one-sixth of its own depressed length. In *morhua* the length of the depressed dorsal is equal to or greater than the distance from the posterior edge of the eye to the origin of the first dorsal. In *macrocephalus* from Japan, Alaska and Puget Sound, the length of the depressed dorsal is less than the distance from the eye to the origin of the first dorsal fin. *G. ogac* is similar to *morhua* in regard to this character.

4. *The color of the fins.* The distal margins of the fin rays in all of the vertical fins of *macrocephalus* are whitish; the lower parts of the fin rays are densely pigmented and blackish, sharply contrasting with the white edges. On the anal and caudal fin the white band of color is wider than in any of the three dorsal fins, averaging about one-third to three-fourths the diameter of the pupil. In *morhua* the color of the margin of the anal fin is similar to that found in *macrocephalus,* but the three dorsal fins and the caudal fin lack the white margin, as the blackish color continues to the tips of the fin rays. In *ogac* the color of the margins of the vertical fins is similar to that of *morhua.*

5. *The length of the barbel.* Although the barbel varies considerably in length, it is longer in *macrocephalus* than in *morhua* or *ogac.* Contrasting the length of the barbel with the diameter of the eye we find that in *macrocephalus* it is longer than the eye in the adults whereas in *morhua* it is shorter than the eye. Kendall (1909: 216) stated that the barbel in *ogac* is equal to or longer than the eye. In the young of both species the barbel is equal to or a little shorter than the eye. The length of the barbel in *ogac* is intermediate between that of *morhua* and *macrocephalus.*

Gadus macrocephalus does not seem to differ from *G. morhua* or *G. ogac* in regard to the number of fin rays, vertebrae or numerous measurements involving various parts of the body and fins. We find that the fin ray counts made on *G. morhua* by Williamson (1902: 239) and Bigelow and Welsh (1925: 410) as well as other authors agree with our counts[3] on *macrocephalus* and *ogac.* Since among these three species our counts of the fin rays did not differ significantly we list the combined data: first dorsal 11 to 14, usually 12 or 13; second dorsal 14 to 21, usually 16 to 19; third dorsal 14 to 20, usually 16 to 18; first anal 16 to 24, usually 18 to 20; second anal 14 to 19, usually 16 or 17; pectoral 16 to 22, usually 18 to 20. The number of vertebrae vary from 51 to 57 in *morhua* (50 to 60 according to Schmidt, 1930), and we find 51 to 56 in *macrocephalus;* and in *ogac* 53 to 57.

[3] The last two rays were counted as one. Our data were taken from 35 specimens of *G. morhua;* 49 of *G. macrocephalus* and 12 of *G. ogac.*

In general the Atlantic and Pacific codfish are very similar, except for the differences indicated above.

The specimens of *macrocephalus* at hand from Japan seem to differ from our American specimens from Puget Sound and Alaska chiefly in having a shorter barbel, a longer first dorsal fin, a darker lateral line, a more slender body in the adult, and possibly a wider interorbital space. At first we suspected that Tilesius (1810: 350, pls. 16 and 17) might have had this form in Kamtchatka, but an examination of his plates indicate that he had the common Alaska codfish. We are not prepared at this time to pass definite judgment on the status of the Japanese form. A final solution of the problems involving the nomenclature and relationships of the northern cods may need to await the examination of specimens representing the recently described subspecies, *Gadus callarias maris-albis* Derjugin (1920), *Gadus callarias kildinensis* Derjugin (1925), and *Gadus callarias hiemalis* Taliev (1931), from the White Sea and the Barents Sea along the northern coast of Europe. We lack accurate translations of the papers in Russian which discuss this question, such as those by Essipow (1931), Lanschin (1928) and Knipovich (1926). We note that Vladykov (1933: 30) found resemblances between *ogac* and other cods for he remarked:

> It is interesting to note that *Gadus callarias maris-albi* Derjugin, living in the White Sea, possesses the following characters similar to *G. ogac:* (1) Darker coloration, (2) larger interorbital space, (3) shorter caudal peduncle, and (4) higher first dorsal and anal fins.

We are of the opinion that our specimens from Japan are somewhat intermediate between *G. ogac* and *G. macrocephalus* as the latter is represented by specimens from the northeastern Pacific Ocean.

The status of Eleginus gracilis (Tilesius)

The genus *Eleginus* was formally recognized as distinct from all other genera of Gadidae when Gill (1891: 303-305) found that Fischer (1813: 252-257) had long before described an essential character of the genus, namely, the swollen tips of the transverse processes of the abdominal vertebrae. This character is the only one which has been used in distinguishing *Eleginus* from *Microgadus*. N. B. Scofield (1899: 507-508) reexamined this character and wrote:

> We have compared the skeleton of this with the skeleton of *Microgadus proximus* (San Francisco) and find but very little difference in the skulls. There is no difference in the character of the neural spines of the vertebrae, but there is a difference in the character of the transverse processes. In *M. proximus* they are plate-like, while in *E. navaga* they are club-shaped, narrow where they leave the centrum, but expanding into a round, hollow bulb at the distal end.

Chranilov (1930) pointed out that *"Gadus gracilis"* and *"Gadus navaga"* are distinct species. He stated that *gracilis* differs from *navaga* in having a greater number of abdominal vertebrae, a wider interorbital space and a greater number of gill-rakers on the first gill arch. The most important distinction which he found to separate the species involves the swollen tips of the transverse processes, which receive an outpocketing of the air bladder. This series of swollen tips begins on the ninth vertebra in *gracilis* and on the sixth in *navaga*. The transverse processes are longer and the swollen tips

are much larger in *navaga* than in *gracilis*, so that the latter is considered intermediate between *Eleginus* and *Gadus* in that respect. A careful dissection of Alaskan specimens of this genus shows that the series of swollen tips of the transverse processes begins on the ninth abdominal vertebra. Therefore, according to this evidence, we must call our American form *Eleginus gracilis* Tilesius instead of *Eleginus navaga*, the name used in current American literature.

Comparison of Eleginus gracilis with Microgadus proximus

Figures 8 and 9

No careful comparison of the external features of the species referred to *Eleginus* and *Microgadus* appears to have been made. Up to the present time, the two Pacific forms have been correctly separated only by the difference in the structure of the transverse processes and their swollen tips (Jordan and Evermann, 1898: 2532). Evermann and Goldsborough (1907: 347-348) attempted to separate *gracilis* and *proximus*, but since none of their alleged differences hold, we are convinced that they confused the two species. They wrote:

> The usual descriptions of *Eleginus navaga* [= *gracilis*] and *Microgadus proximus* refer to the same characters so seldom, except in features in which they happen to be alike, that from these characters it is impossible to compare the species, and the only way given to separate them is by dissection and a comparison of the transverse processes of the vertebrae. We find that the following comparisons are helpful, and that the species may be separated by their use:
>
> In *proximus* the first dorsal has 14 rays.
> In *navaga* the first dorsal has 13 rays.
> In *proximus* first anal base = second dorsal base, and is 1.5 in head.
> In *navaga* first anal base = second dorsal base, and is 1.15 in head.
> In *proximus* the barbel is longer than pupil.
> In *navaga* the barbel is equal to or less than the pupil.

Our counts of the fin rays in *Eleginus gracilis* and *Microgadus proximus*, and also in the Atlantic *Microgadus tomcod* are as follows:

Eleginus gracilis: dorsals, 12 to 16 (average 13.7)—17 to 20 (18.4)—18 to 21 (19.6); anals, 20 to 22 (21.3)—19 to 21 (20.3); pectoral, 18 to 22 (20.1).

Microgadus proximus: dorsals, 11 to 14 (12.2)—17 to 20 (18.5)—18 to 20 (18.8); anals, 20 to 25 (22.5)—18 to 21 (19.7); pectoral, 17 to 22 (19.1).

Microgadus tomcod: dorsals, 11 to 14 (12.9)—15 to 19 (16.7)—16 to 18 (17.0); anals, 18 to 23 (20.7)—16 to 19 (17.5); pectoral, 16 to 19 (17.1).

Our measurements indicate for both species that the first anal fin base averages longer than the second dorsal fin base. The anal and dorsal fin bases in *proximus* are contained in the head respectively, 0.85 to 1.35 (average 1.11) and 1.04 to 1.65 (1.37) times; in *gracilis*, 1.05 to 1.45 (1.19) and 1.15 to 1.65 (1.29) times.

In *proximus* we find that the barbel is shorter than the pupil, and is contained in it 1.0 to 1.8 (average 1.3) times, while in *gracilis* the barbel is also shorter than the pupil and is contained in it 1.0 to 1.6 (1.4) times. In the

larger specimens of both species the barbel becomes longer in proportion to the diameter of the pupil, sometimes becoming as long as the pupil, but in none of our fish is it longer.

Additional evidence proves that Evermann and Goldsborough did not properly separate *Eleginus* from *Microgadus*. Most of the specimens which served as the basis for their records of *Eleginus navaga*, including all which provided the only records for Puget Sound, on being reexamined with the kind permission of the authorities of the U. S. National Museum, prove to be

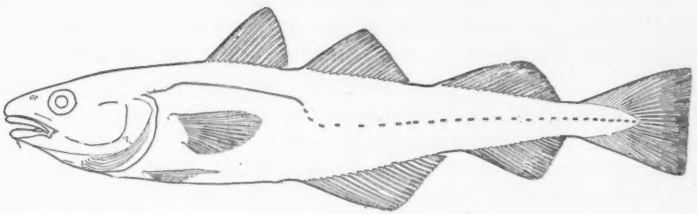


Fig. 8. *Eleginus gracilis* (*E. navaga* of American authors).
Drawn from specimen taken in Sitkalidak Straits, Alaska. Standard length 215 mm.

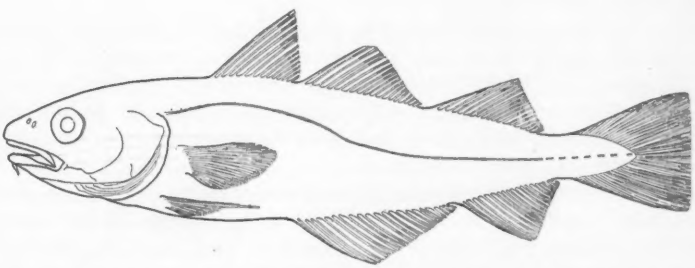


Fig. 9. *Microgadus proximus*, from Yaquina Bay, Oregon. Standard length 193 mm.

referable to other genera *(Microgadus, Gadus* and *Theragra)*. The corrected identifications follow:

Albatross Sta. 4202, off Fort Rupert, Vancouver Island: one, *Gadus macrocephalus*, 53 mm.

Sta. 4213, near Port Townsend, Washington: one, *Theragra chalcogramma fucensis*, 58 mm.

Sta. 4218, near Port Townsend: six, *Microgadus proximus*, 53 to 69 mm.; one, *T. c. fucensis*, 43 mm.

Sta. 4219, near Port Townsend: three, *M. proximus*, 45 to 56 mm.; three, *T. c. fucensis*, 49 to 62 mm.

Sta. 4220, near Port Townsend: four, *M. proximus*, 41 to 56 mm.

Stas. 4268, 4271 and 4272, in Afognak Bay, Afognak Island: one *G. macrocephalus* at each station, respectively 59, 50 and 60 mm.

Sta. 4275, Alitak Bay, Kadiak Island; one, *G. macrocephalus*, 54 mm.

Stas. 4277 and 4278, Alitak Bay: six, *T. c. chalcogramma,* respectively four 41 to 52 mm. and two 38 to 46 mm. (two specimens from Sta. 4276, in the same bay, not listed by Evermann and Goldsborough, are also *T. c. chalcogramma,* 38 and 48 mm.).

Uyak Bay and Port Alexander: five, *G. macrocephalus,* respectively three 51 to 59 mm. and two 60 to 66 mm.

Admiralty Island (Whidby Island): three, *M. proximus,* 37 to 45 mm.

Litnik Bay: four, *Eleginus navaga,* 49 to 58 mm. This is the only record for this genus by Evermann and Goldsborough which we have been able to confirm.

The specimens recorded by these authors from Karluck, Unalaska, and from Petropaulovsk and Tareinski Harbor, Kamtchatka, have not been checked.

Externally *Microgadus proximus* differs from *Eleginus gracilis* in the following respects: (1) The shape of the first dorsal fin; (2) the position of the anus, and (3) the curvature and structure of the lateral line.

1. The first dorsal fin of *M. proximus,* when fully extended at an angle of about 45° with the longitudinal axis of the body, has a pointed tip and a truncate posterior margin which fails by only 5° of being vertical to the axis of the body. In *gracilis,* this fin when thus fully extended, has a rounded tip and a rounded posterior margin, which fails by at least 20° of being vertical to the axis of the body. The rays of the first dorsal fin, when fully depressed, are long enough in *proximus* to extend beyond the origin of the second dorsal, a distance equal to about one-fifth of the length of the depressed first dorsal, whereas in *gracilis* the depressed first dorsal scarcely reaches the origin of the second dorsal fin.

2. The anus is farther forward in *proximus* than in *gracilis* in reference to the total length: the distance from the snout to the anus averages 2.38 and 2.23, respectively, in the standard length. The anus in *proximus* is farther forward, however, in reference to the dorsal and paired fins. It is usually under the posterior fourth of the first dorsal fin base in that species, while in *gracilis* it is usually under the posterior edge of the first dorsal fin base or below the interspace between the first and second dorsal fins. The anus of *proximus* is much closer to the base of the ventral and pectoral fins than in *gracilis.* This obvious difference among the three forms, *E. gracilis, M. proximus* and *M. tomcod,* is clearly indicated by dividing the distance from the base of the ventral to the anus, respectively, (1) by longest pectoral ray—1.4 to 2.0 (average 1.62), 0.8 to 1.5 (1.12), 1.0 to 1.2 (1.11); (2) by longest ventral ray—1.7 to 2.4 (1.98), 0.9 to 1.5 (1.19), 0.9 to 1.2 (1.08); (3) by length of first dorsal fin base—1.5 to 2.4 (1.83), 1.1 to 1.7 (1.33), 1.0 to 1.5 (1.30); (4) by length of second dorsal fin base—1.0 to 1.5 (1.23), 0.7 to 1.1 (0.87), 0.8 to 1.0 (0.85); (5) by length of third dorsal fin base—1.3 to 1.9 (1.57), 0.8 to 1.3 (1.05), 0.9 to 1.1 (1.02); (6) by length of first anal fin base—0.9 to 1.4 (1.11), 0.6 to 0.9 (0.71), 0.6 to 0.8 (0.72); (7) by length of second anal fin base—1.2 to 1.9 (1.49), 0.7 to 1.4 (1.01), 1.0 to 1.2 (1.07); (8) by length of depressed first dorsal—1.3 to 1.9 (1.54), 0.8 to 1.4 (1.07), 0.9 to 1.3 (1.10). The distance from the insertion of the ventral fin to the anus is contained in the head 1.2 to 2.1 (1.55) times in *proximus* and 0.9 to 1.3 (1.10) times in *gracilis.*

3. The lateral line of *proximus* is evenly curved over the pectoral fin and slopes gently downward behind that fin, reaching the axis of the body below

the posterior tip of the second dorsal fin. In *gracilis* the lateral line forms a flat-topped arch anteriorly and drops abruptly down to the axis of the body below the first third of the second dorsal fin, where it breaks up into separate tubes. In *proximus* the lateral line first breaks up into separate tubes near the caudal peduncle.

Internally, we find other differences between *Eleginus gracilis* and *Microgadus proximus*. The latter has 55 to 58 (average 56.2) vertebrae, while *E. gracilis* has 60 to 62 (61.4). *M. tomcod* has 53 to 57 (54.8) vertebrae. Careful dissections around the posterior portion of the air-bladder in various cods (Table 1) show that the air-bladder ends under the 30th to 33rd vertebra in *gracilis* and under the 28th to 30th in *proximus*.

We conclude from this study that *Eleginus gracilis* and *Microgadus proximus* are readily distinguishable externally as well as internally.

TABLE 1. THE NUMBER OF THE VERTEBRA UNDER WHICH THE AIR BLADDER ENDS, IN VARIOUS SPECIES OF COD

	The number of the vertebra under which the air bladder ends													
Species of cod:	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*Average*
Eleginus gracilis	..	..	..	..	..	..	..	..	..	1	11	7	1	31.4
Microgadus proximus	..	..	..	..	..	..	..	3	12	5	..	..	..	29.1
Microgadus tomcod	..	..	..	..	..	..	3	3	1	..	..	..	..	27.7
Gadus ogac	..	..	1	12	3	..	..	..	..	..	..	..	..	24.1
Gadus macrocephalus	..	3	8	7	1	..	..	..	..	..	..	..	..	23.3
Gadus morhua	2	10	2	..	..	..	..	..	..	..	..	..	..	22.0
Theragra chalcogramma	..	2	13	4	..	..	..	..	..	..	..	..	..	23.1

The subspecies of Theragra chalcogramma (Pallas)

Theragra chalcogramma (Pallas, 1811: 198) has been considered as divisible into two subspecies, *T. c. chalcogramma* of northeastern Asia and Alaska and *T. c. fucensis*, since Jordan and Gilbert (1894: 315) described the latter from Puget Sound, Washington. This subspecific separation was originally based on only four specimens from Puget Sound and three from Alaska, an inadequate number. We have made additional fin ray counts for Alaska (30 specimens) and Puget Sound (27 specimens), as follows:

Alaska specimens *(T. c. chalcogramma):* dorsals, 10 to 13 (average 11.90)—14 to 18 (15.38)—15 to 20 (17.70); anals, 17 to 22 (20.10)—16 to 21 (18.67).

Puget Sound specimens *(T. c. fucensis):* dorsals, 11 to 13 (11.44); 12 to 15 (13.23)—14 to 19 (16.44); anals, 15 to 19 (17.80)—15 to 19 (17.26).

The Alaskan specimens therefore show an increased number of rays in each fin (the difference is slight for the first dorsal). The average differences are 0.46 for the first dorsal, 2.15 for the second dorsal, 1.26 for the third dorsal, 2.30 in the first anal, 1.51 in the second anal. Counts of the number of fin rays in specimens of *Theragra* from Bering Sea, given by Scofield (1899: 507) agree closely with our counts of Alaskan specimens. The Alaskan specimens have 50 to 52 (51.26) vertebrae, and Puget Sound specimens have 49 to 51 (49.96), a difference of 1.30 vertebrae.

The differences indicated above appear to represent the usual trend among most fishes, namely an increase in the number of segmental units in waters of

lower temperatures. Since the difference in the number of fin rays is not very great between Puget Sound and Alaska, the character may not prove usable for the subspecific determination of additional specimens from intermediate localities, or representing various additional year classes. While we doubt that the separation of the two subspecies of *Theragra chalcogramma* will be maintained, we do not venture to synonymize them on the available evidence.

Note on Boreogadus agilis (Reinhardt) and Arctogadus pearyi (Nichols and Maxwell)

The only specimens of either of these genera studied by us were some of *Boreogadus* collected in Godhavn Harbor, Greenland, by Dr. Walter Koelz. These correspond in all respects with *Boreogadus agilis* (Reinhardt), as differentiated by Svetovidov (1935), except that the head, body and fins are finely covered with black specks.

Nichols and Maxwell (1933: 26) described *Boreogadus pearyi* as a new cod from Lincoln Bay, Greenland, characterized by having a row of well spaced unequal teeth on the vomer and on the palatines. Since this is the main character which distinguishes the genus *Arctogadus* (Drjagin, 1932: 151) from *Boreogadus,* the species *pearyi* may be referred to *Arctogadus.* Since *Arctogadus borisovi* was taken along the northeast coast of Siberia and *Arctogadus pearyi* in Greenland, we expect that the genus will be found to be represented in Arctic America along with *Boreogadus.*

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Ichthyological Notes

SOME FEEDING HABITS OF THE COMMON EEL *(ANGUILLA BOSTONIENSIS)*.—During August, 1934, many eels of the species *Anguilla bostoniensis* were observed in the inclosure surrounded by the pier of the United States Bureau of Fisheries, Woods Hole, Massachusetts. Opportunities were afforded to observe certain feeding habits of these fish and to note facts which may well be placed on record.

A number of these eels, estimated at approximately 50, were seen on August 17, at 7:45 P.M., coming from lower depths and swimming about the pier at a depth of about 4 feet. At this time the sun was low, but still visible. As the sun gradually passed below the horizon, these fish came to the surface of the water and fed upon young fish of the herring family. According to Mr. Robert Goffin, United States Bureau of Fisheries, the smaller of the fish on which the eels were feeding were menhaden, the larger, alewives. These small fish were observed in schools of several hundred. As many as 12 to 15 eels were observed following a single school of the young clupeids, and the eels were clearly seen to capture the small fry from these schools. These young fish, in attempting to escape from the eels, frequently broke the surface, leaping from the water. So great was their activity that at a distance of some feet, the water appeared in constant turmoil. While the eels were actively feeding, a number were captured by being scooped from the surface with a dip-net. Upon subsequent examination, larval fish, both menhaden and alewife, were found in the stomachs of the eels.

As darkness approached, at 8:15 P.M. (Eastern Standard Time), the eels quickly disappeared from the surface, descended to greater depths and ceased feeding upon the young fish which were still schooling near the surface.

The earliest appearance on the following day, August 18, was again at 7:45 P.M., and the descent occurred as before at 8:15 P.M. On the next day, August 19, the eels were not feeding, but appeared at 7:39 P.M. No schools of the smaller fish, which the eels had been using for food, were seen. Their absence may have been due, at least in part, to the fact that a strong breeze from the southwest was blowing at the time, whereas the two previous days had been calm. A few eels were seen swimming slowly about as late as 7:50 P.M. There was on this day no appearance and disappearance at all comparable to the activities observed upon the two previous days. On the relatively calm evening of August 20, the eels were first seen at 7:43 P.M. Feeding upon the schools of menhaden and alewife again occurred much as has been noted for August 17 and 18, and a disappearance or descent into deeper water followed at approximately 8:10 P.M.

The time of appearance and departure of these eels was so definite as to lead to the suggestion that the activities were influenced by light conditions. It was definitely determined that the eels remained about the pier during the day, since throughout the day many could be observed resting quietly among the algae along the piles and stone walls of the pier.—FLOYD J. BRINLEY and R. E. BOWEN, *North Dakota Agricultural College, Fargo, North Dakota*, and *Long Island University, Brooklyn, New York*.

HORSE MACKEREL OFF BRITISH COLUMBIA.—This records the capture in a pilchard purse seine of two specimens of *Trachurus symmetricus* about 21 inches long, 20 miles off Nootka, Vancouver Island, on August 27, 1934.—J. L. HART, *Pacific Biological Station, Nanaimo, British Columbia*.

NOTE ON THE GOBY *BIAT LUZONICUS*.—In COPEIA for April 10, 1935, on page 19, Dr. H. A. Roxas has a very interesting article entitled *Rediscovery of Biat luzonicus Seale (Gobiidae)*. While Dr. Roxas has added much to our knowledge of this rare goby, he is in error when he states that his specimen is the second one taken. On page 91 of my *Fishes of the Herre Philippine Expedition of 1931*, a copy of which was presented to the Fish and Game Administration, I list under No. 881 three specimens of *Biat luzonicus*. One I obtained from Lamon Bay, the type locality on the east coast of Luzon, one from Alabat Island a little way south, and one from Cebu. My specimens were respectively 125 mm., 112 mm., and 101 mm. in length. Dr. Roxas' specimen, 180 mm. long, is therefore the fifth one known, but is the largest and finest one yet taken. —ALBERT W. HERRE, *Zoological Museum, Stanford University, California*.

IDENTIFICATION OF *SCLEROCOTTUS SCHRADERI* FISCHER, 1885.—Through the courtesy of Dr. Erna Mohr I have been able to examine the unique type specimen of *Sclerocottus schraderi*, described by Fischer from South Georgia (Jahrb. Hamburg. Wiss. Anst., 2, 1885: 58). The occurrence of a member of the family Cottidae in the Southern Hemisphere led me to suspect the accuracy of the type locality, and examination of the fish leaves no reasonable doubt that it is an example of *Gymnocanthus tricuspis* (Reinhardt), a widely distributed species in arctic and subarctic seas. Dr. Mohr informs me that her investigations lead her to suppose that the mistake occurred in the museum at Bremen, from which the specimen in question was transferred with a number of others to the Zoological Museum at Hamburg. It appears that collections of fishes from Arctic seas were dealt with at Bremen at the same time as one from South Georgia, and it seems reasonable to suppose that some confusion of labels must have taken place and that Dr. Fischer was misled as to the source of this specimen. It is of interest to note that the same author described a species of *Cottus* from Barbados, which was subsequently shown by Dr. T. H. Bean to be the common Father-lasher, *Cottus bubalis*, Euphrasen, of the coasts of northern Europe.—J. R. NORMAN, *British Museum (Natural History), Cromwell Road, London, S.W. 7, England.*

NOTES ON THE SPAWNING HABITS OF THE ATLANTIC SMELT.—The following observations made in 1928 upon the spawning habits of the Atlantic smelt (*Osmerus mordax* Mitchill) may have some value for anyone who may be studying the biology of this species, which has become well established in the Great Lakes in recent years (Creaser, 1925).

The smelt of Crystal Lake, Benzie County, Michigan, spawn when the ice is going out in the spring. Their principal migration is from the lake into Cold Creek, a tributary entering the lake at the east end. The lowermost six hundred feet of the creek, from 6 to 10 feet wide and from 6 to 24 inches deep, with a considerable grade and a bouldery bottom, presents true rapids conditions. Though the smelt have access to all of the headwaters of the creek the great majority of them do not ascend above this zone of rapids.

The spawning migration consists of a nocturnal ascent into the creek with no return to the lake until the coming of daylight; some fish remain in the creek on dull days. The smelt always swim close to the bottom and always head upstream, even when drifting down. The run lasts about two weeks; the toll taken from each night's run indicates that fresh arrivals form the majority of each night's migrants. On the first night of the run in 1928 none but males were taken, but on the second night 5.6% were females, and this percentage increased until the fifth night when the females constituted 63.5% of the run. From then until the end of the run the sex proportion shifted during each night from a majority of females in the early evening to a majority of males in the morning. These observations are in essential accord with those of Greene (1930: 116) on the smelt of Canadaigua and Owasco lakes, New York.

Many times a smelt may be seen to flash its lighter colors by turning onto its side, and this frequently may be seen a number of times in succession from the same location in the stream, downstream from a rock or ridge. This flashing of colors was seen on April 4 in Cold Creek just above the Clark Street bridge in the pocket between an embedded log and an anchored box. The following observations were made from 11:05 to 11:45 A.M., during a hard rain, when the air was at 43° F. and the water was at 48° F. Surface reflection was eliminated by using a plate of glass, which vastly increased the visibility of the bottom and of the fish. The sexes of the smelt are easily distinguishable in the water by use of the following characters: (1) although the scales of both sexes have many minute tubercles, those of the male also have a very pronounced ridge running lengthwise of the scale, making them look rough in contrast to the smooth scales of the females; (2) the backs of the males are normally darker than those of the females; (3) since almost all of the larger fish in our collections were found to be females, size, combined with the other features, makes sex recognition definite.

The spawning fish observed were nearly constant in position, close to but not actually touching the bottom, and all heading upstream. The pocket downstream from the embedded log had a depth of 14 inches, and its bottom sloped down sharply from the angle made by log and anchored box. The current swung down through the pocket,

from the angle toward the middle of the stream, and the spawning fish lay close to the sloping surface, facing the angle. The bottom material was coarse gravel, with a slight intermixture of sand. The spawning group consisted of 1 female and 5 males. The female, about 10 inches long, longer by about 2.5 inches than the attendant males, occupied a position farther up the slope than the males, and retained this position for a full half hour. She held her snout between two 2-inch stones that rose above the bottom, and that may have assisted her to maintain her position against the current. At the end of the half hour a second and smaller female displaced her by intruding her snout between the same two stones. The larger female dropped back for a few minutes, but the smaller female also dropped back and out of the pocket, whereupon the first female presently re-occupied her place.

All 5 males were downstream from the female all of the time, though they shifted their positions laterally from time to time. The most advanced on each side of her had his head about abreast the mid-length point of the female's body, while the other three were approximately opposite the tip of her tail or a little below that point several inches apart.

While holding her head position constant, the female swayed her body from side to side in a 5 or 6 inch swing, apparently following changes in the water currents. As she swayed, little clusters of eggs were seen to be falling from her vent. There seemed to be no regularity in the rate of ejection, but a series of clusters were ejected at a time, followed by an interval when no falling eggs were to be seen. The eggs were carried by the current as they fell, some reaching the bottom underneath the bodies of the males, some stopping before going that far, and some going beyond. The egg clusters adhered to whatever they first touched and each pebble of the bottom presently became possessed of one or more of them. In spite of carefully directed attention, no milt could be seen leaving the males. Sometimes as the female swayed from side to side, laying her eggs, at one end of a sway her body listed to one side, showing her lighter colors. This is the flash one sees so commonly repeated a number of times behind the same boulder.

These observations corroborate those of Kendall (1927: 297-298), who noted the behavior without actually seeing oviposition.

Size of Eggs.—Eggs taken from a 232 mm. smelt averaged .035 inch in diameter. Sixteen eggs selected at random from the mass stripped from 14 females ranging from 185 to 195 mm. in length had the same average diameter of .035 inch. According to von Bayer's table for computing the number of fish eggs per quart by using the diameter of the egg, there are 1,578,320 eggs of .035 inch diameter per quart.

The formalin-hardened eggs of a 232 mm. female smelt formed a volume of 28 cc., and this volume contained, by careful count, 43125 eggs. This gives the figure of 1540 eggs per cc., and 1,457,625 eggs per quart. According to von Bayer's table there are 1,450,406 eggs per quart of eggs having a diameter of .036 inch. These two figures tally so closely that the actual average egg diameter probably is .036 inch rather than .035 inch as measured.

Number of eggs per female smelt.—As cited above, one 232 mm. female smelt contained 43125 eggs, but this fish was longer than the average. 14 females, ranging in length from 185 to 195 mm., yielded a total volume of 228 cc. of hardened eggs, or 16.3 cc. per female. At 1540 eggs per cc., these females averaged 25102 eggs each. Kendall counted 5893 eggs from a smelt 4⅝ inches long from Maine, but made no counts on larger fish.

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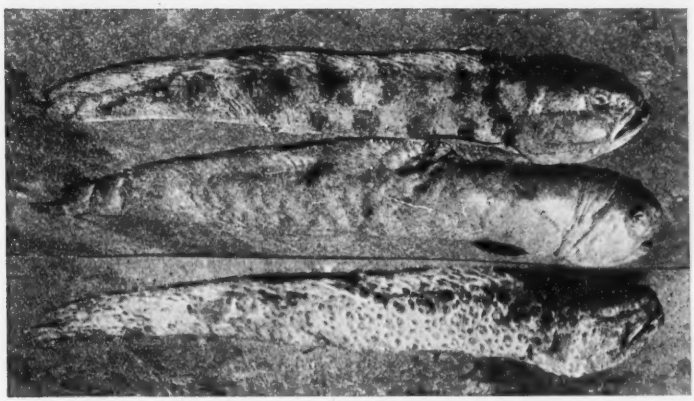
T. H. Langlois, *Ohio Department of Conservation, Columbus, Ohio.*

NOTES ON A RARE TYPE OF WOLFFISH, *LYCICHTHYS LATIFRONS*, FROM THE NOVA SCOTIAN BANKS.—On May 23, 1935, Mr. William A. Ellison, Jr., of the Portland Trawling Company called the writer's attention to an unusual type of wolffish that had been brought in to the Fish Pier at Boston, Massachusetts, that day by the steam trawler Brant. Since the ship's catch also included the two common species of wolffish, *Anarrhichas lupus* and *Anarrhichas minor*, there was an excellent opportunity for comparison. A most superficial examination made it at once apparent that this fish was completely different from the other two species. It was later identified as *Lycichthys latifrons* (Steenstrup and Hallgrimsson). Since there are few definite records of this species and so little is known about it, the following information may be of value.



The three species of wolffish of the North Atlantic coast.
From top to bottom, *Anarrhichas lupus*, *Lycichthys latifrons* and *Anarrhichas minor*. All from lat. 41° 06′ N., long. 58° 52′ W. About 1/12 natural size.

The specimen was taken in lat. 44° 06′ N., long. 58° 52′ W., on the southwest corner of Banquereau Bank in 73 fathoms of water. This locality has a smooth sand and gravel bottom. All three species, *(A. lupus, A. minor,* and *L. latifrons)* were taken in the same haul. The specimen of *L. latifrons* measured 118.5 cms. and weighed 37½ lbs. It was a male.

In view of the recent publication by Bigelow and Schroeder,[1] a survey of the literature on this species or a discussion of the field characters by which the fish may be immediately distinguished from its close relatives is unnecessary. Suffice it to say that its uniformly dull yellowish grey or brown color, the extraordinarily flabby and jelly-like condition of its flesh, and its tooth structure, are outstanding features of *Lycichthys latifrons*. The cleft in the tail and gap in the dorsal fin which are indicated in Bigelow and Schroeder's plate as probably being unnatural or the result of mutilation, were not evident in this specimen. The dorsal fin rays, however, actually appeared to be rudimentary at the point where they have shown a gap, although the flesh had grown up in such a manner as to suggest the normal continuity of the fin. It is of interest to note that the opening of the urinogenital duct was minute and far less prominent in this specimen than in that shown in Bigelow and Schroeder's plate; such a difference is probably characteristic of the male and female of the species.

This specimen has been deposited in the United States National Museum.—DANIEL MERRIMAN, *Zoology Department, Yale University, New Haven, Connecticut.*

[1] Proc. Boston Soc. Nat. Hist., 41 (2), 1935: 15-18, pl. 3.

Herpetological Notes

THE SPECIFIC NAME OF THE ANACONDA.—In Miss Stull's very welcome and very useful *Check List of the Family Boidae* (Proc. Boston Soc. Nat. Hist., 40 (8), May, 1935: 403), I note a change in the specific name of the Amazonian anaconda, a snake which up to the present time has been known almost unanimously for more than a hundred years as *Eunectes murinus* (Linnaeus). No reason for the change of the name is given, and only the reference *Boa Scytale* Linné, *l.c.* [Syst. Nat., ed. 10, 1758, vol. 1, p.] 214, is cited, while Linné's *Boa murina* is described on p. 215. If the assumption that the change is made on the ground of "page priority" is correct, the change is not justified by the International Rules of Zoological Nomenclature, the 28th article of which provides:

> A genus formed by the union of two or more genera or subgenera takes the oldest valid generic or subgeneric name of its components. If the names are of the same date, that selected by the first reviser shall stand. The same rule obtains when two or more species or subspecies are united to form a single species or subspecies.

The facts in the case are these:

In the 10th edition of the *Systema Naturae* (1, 1758: 214), Linnaeus describes—or diagnoses—a *Boa scytale* as having 250 ventrals and 26 subcaudals, "color ex albo nigroque undulatus" and "Squamae capitis majores." He refers to it as synonyms Gronovius, *Museum* (2: 55, n. 10) and Scheuchzer's *Phys. sacr.* (tab. 737, fig. 1). Schlegel (Physion. Serp., 2, 1837: 56) identifies the latter with *Erythrolamprus venustissimus*, but whether the references can be identified or not, Linnaeus' diagnosis cannot by any stretch of the imagination be made to fit the anaconda so as to compel us at this late day to accept *scytale* as the specific name of the species which Linnaeus a few lines below on the next page indisputably names *Boa murina*, even if article 28 of the code did not exist.

In 1766 Linnaeus (Syst. Nat., ed. 12, 1: 374) changed the diagnosis of *Boa scytale* to fit a snake with 250 ventrals and 70 subcaudals and having a "corpus cinereo-glaucum: maculis dorsalibus orbiculatis nigris," and drops the reference to Gronovius No. 10. This 1766 *scytale* is therefore applicable to the anaconda but is a species quite different from the 1758 *scytale*, as already pointed out by Schneider (Hist. Amph., 2, 1801: 248). Though of no importance it may be noted that in the 12th edition *murina* has "page priority" over *scytale*.

Possibly Gray may be quoted as the first reviser to unite *B. murina* and *B. scytale* and select *B. murina* for the combination, inasmuch as in Griffith's *Animal Kingdom* (vol. 9, 1831), in the Synopsis of the species at the end of the volume, on p. 96, he enumerates *Eunectes murina* with "*Boa murina, Boa scytale*, Linn. Seba" among the synonyms.

But the first reviser who actually and distinctly united Linnaeus' *Boa murina* and *B. scytale* under the former name, and thus preserves it for the anaconda under the International Rule, art. 28, is Schlegel in his *Physionymie des Serpens* (2, 1837: 380). In the *Check List* therefore, the entry ought to be:

68. *Eunectes murina* (Linné)

Boa murina Linné, l.c., 215.
Boa murina Schlegel, Physion. Serp. II: 380.
Eunectes murina Gray, Synops. Rept., p. 96, in Griffith, Anim. Kingd. Cuvier, vol. 9, 1831. (Wagler, 1830, uses nowhere the combination *Eunectes murina*).
Eunectes murinus Duméril and Bibron, l.c., 528; Boulenger, l.c. I: 115.

LEONHARD STEJNEGER, *U. S. National Museum, Washington, D. C.*

AN ABNORMAL PATTERN IN A GOPHER SNAKE.—Since the blotched pattern of the coast gopher snake (*Pituophis catenifer catenifer*) ordinarily varies only in minor details, a specimen having a strikingly abnormal pattern aroused special interest and was thought to merit a detailed description. The snake was found April 7, 1933, coiled under a rock on a grassy hillside three miles southwest of Vacaville, Solano County, California.

The specimen, an adult male, is now catalogued as number 16329 in the Museum of Vertebrate Zoology of the University of California. It was photographed before being preserved (fig. 1). In characters other than those of pattern, it is apparently normal. It has a total length of 1103 mm. The scale characters of this specimen may be summarized as follows: loreals, 1–1; praeoculars, 1–1; postoculars, 3–3; supralabials,

8–8; infralabials, 13–13; gastrosteges, 214; urosteges, 64. The dark and light markings are mainly of the same color tones as are found in normal *c. catenifer*.

The pattern is abnormal in having the dark markings in continuous longitudinal stripes instead of in series of blotches. On the anterior portion of the body where the pattern is best developed there are, including a narrow mid-dorsal line, seven dark

Fig. 1. A gopher snake (*Pituophis catenifer catenifer*) in which the series of dark blotches normally present are replaced by continuous longitudinal bands.

stripes on the lighter ground color. The lower stripe is distinct and well defined throughout its length on the body and terminates opposite the anus. Above it the two more dorsal of the lateral stripes on each side are irregular and not well separated from each other. In the middle portion of the body they partly merge, producing chain-like markings. The dark lateral stripes of the most dorsal pair are separated from each other on the body by a light area involving the medial dorsal scale row and half a scale row on each side of it. Each scale of the median row has a longitudinal dark area in its center, and these dark markings form a line along the back. For a short distance behind the head, and on the tail, the stripes of the dorsal pair tend to fuse with each other medially, obliterating the light area which separates them throughout the greater length of the body. The band so formed on the tail shows a tendency to break up into median blotches. The stripes of the next lower pair are increasingly irregular posteriorly; a short distance in front of the anus they become broken into a series of blotches which are continued onto the proximal two-thirds of the tail. On the anterior third of the body the stripes are of a dark brown hue, nearly black, and are sharply set off from the ground color. In the middle part of the body, they become paler and less distinct, but toward the tail they again become well defined.

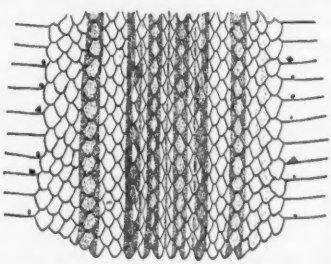


Fig. 2. Selection from anterior portion of body to show position of bands.

In this specimen the dark ventral spots, normally present, are almost obsolete. Most of the gastrosteges on the anterior fourth of the body have small spots not more than 2 mm. in diameter; they are faintly developed on some of the gastrosteges near the tail, but throughout most of the length they are absent.

The specimen is of possible significance as an example of an abrupt variation from

which, if it involves the germ plasm, a new form might arise. Within several groups of snakes there are different forms having respectively the blotched and the striped type of pattern. It is probable that in the evolution of the snakes the transition from one type to the other has occurred many times. The gopher snakes as a group show only the blotched type of pattern. Although none of the recognized forms is longitudinally striped, the group may have the latent potentiality to produce such a striped form when environmental conditions favor its survival.—HENRY S. FITCH, *Museum of Vertebrate Zoology, Berkeley, California.*

NOTES ON THE PYGMY RATTLESNAKE, *SISTRURUS MILIARIUS* LINNAEUS, IN SOUTH CAROLINA.—During the past twenty-five years the Charleston Museum has obtained, in South Carolina, records of fifty-five specimens of the pygmy rattlesnake, locally known as the oak-leaf rattler. About thirty-two of these have been brought to the institution and a few examined in the field. The remaining records have been supplied by reliable collectors or observers.

Analysis of the list of localities in which the species has been collected indicates that this rattlesnake ranges throughout the Coastal Plain and into the Piedmont section of the state. The records by counties are as follows: Berkeley 3, Charleston 40, Dorchester 2, Georgetown 1, Horry 1, (courtesy of Prof. Franklin Sherman, Clemson College), Kershaw 1, (Bryce Herbert, Kershaw), Lexington 3 (Miss Laura Brodie, Leesville), Orangeburg 1, Richland 3. The larger number of records from Charleston County is accounted for by the fact that this region has probably received more attention from collectors than other sections of the state.

Over 65 per cent of the specimens noted were taken during the months of July, August and September. The earliest seasonal record is January 9 (snake found under old stump, but active) and the latest November 21. The entire series shows the following distribution by months: January 1, February 2, March 0, April 1, May 2, June 2, July 9, August 12, September 15, October 6, November 1, December 0, month not recorded 4. From this it appears that some individuals may be active at almost any time during the year except in the coldest weather.

This rattlesnake attains a greater size than is usually supposed. In a series of eighteen the two largest are 552 and 549 mm. long. Six are greater than 450 mm. in total length. The smallest individuals measure 175, 185 mm., and "about 6½ inches" and, since their rattles each consist of one button only, may be newly born or young of the year. In specimens of this size the distal 7 or 8 mm. of the tails are sulphur yellow. The fragile nature of the rattle does not allow permanent retention of the terminal segments. The largest number possessed by any of the specimens observed is five. This snake is 486 mm. in length; others of larger size have lost all but three or four sections.

In the stomach of a specimen 197 mm. long was a disintegrating sac containing a small beetle (*Copris minutus*), the remains of other insects, and a small amount of fine sand. It is thought that this may be the remains of the stomach of a frog or toad.

Regarding life span in captivity our records are not very helpful. Our snakes were offered small mice and young birds, usually without this food being accepted. A few specimens lived 12 months without taking food of any kind. Of ten individuals the average length of life in captivity was 8 months, with a maximum period of 20 months.

While we have a few reports of cases of bites, attributed to this species, none have resulted in death or very serious injury. Two instances have come to my personal attention. On August 3, 1925, Benjamin M. Badger, then of Summerville, Dorchester County, South Carolina, wrote, in part: ". . . he struck me on (the tip of) the middle finger of the right hand. I opened this double puncture and sucked as much of the poison out as I thought possible, and then put crystals of permanganate of potash in it. In two hours my arm was as big as a Ford tire, and just about as hard. That was Saturday (August 1, 1925), and on Monday I am still suffering very much pain. However, the swelling has abated largely and I will soon be alright now, I hope." Later Mr. Badger sent us the snake for positive determination. It was fourteen or fifteen inches in total length. Mr. Badger advises me (March, 1935) that he felt no serious subsequent effects from this bite, although the tip of his finger has never regained the sense of feeling. Perhaps this is a result of the treatment rather than of the bite.

The second case was the result of carelessness on my part. On August 10, 1926,

I started to move some grass on the floor of a cage in order to examine a young, alleged corn snake. Almost immediately I was struck on the inner side of the right thumb, near the nail-base. The bite caused a slight stinging sensation, as though a small bee had stung me. This sensation at once passed away. Apparently only one puncture was made and from this were squeezed two or three drops of blood, a little light in color. A small ligature was then applied to the base of the thumb, and aside from a slight throbbing for fifteen minutes no ill effects were suffered. The young snake lived until September 19, 1926. It then measured 175 mm., including a tiny button.—E. B. CHAMBERLAIN, *The Charleston Museum, Charleston, South Carolina.*

THE IDENTITY AND STATUS OF TWO TURTLES OF THE GENUS *PSEUDEMYS.*—For some time I have been collecting material and data with a view to determining the significance of the peculiar forms of this group which occur in Alachua and neighboring counties in Florida. I have reached the conclusion that *Pseudemys floridana* (LeConte) and *Pseudemys concinna* (LeConte) are southern and northern representatives of the same species, intergrading in northern Florida.

The territory covered by the intergrades apparently extends from the Okefinokee Swamp to central Marion Co., Florida. From here southward the form is stable,

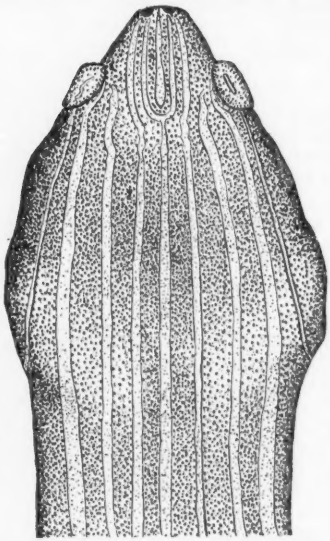


Fig. 1. Dorsal head pattern of *P. f. concinna.*

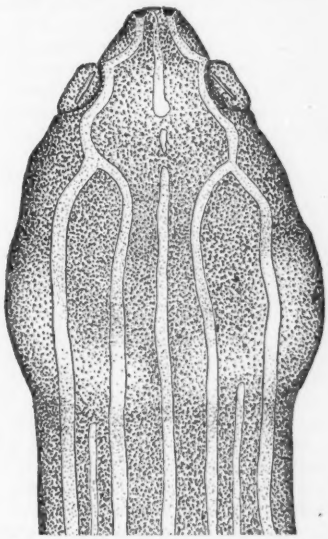


Fig. 2. Dorsal head pattern of *P. f. floridana.*

Lake County specimens being identical with those from Lake Okeechobee and Key Largo.

P. floridana and *P. concinna* were both described by LeConte (Ann. Lyc. Nat. Hist. New York, Vol. 3, 1930). Since the former has page priority, it is the valid name of the species. The typical peninsular race should be called *P. f. floridana* and the northern race, *P. f. concinna.*

The two races may be distinguished as follows:

P. f. concinna.—Color: background of carapace light or medium brown; markings on soft parts bright yellow; plastron light yellow with no greenish tint. Suture between costals and marginals marked by an accessory furrow and ridge, especially posteriorly (except in very old examples); highest point of carapace nearly over middle of its long axis; plastron with anterior upward curve beginning in middle of humerals, and posterior upward curve beginning in middle of anals. Blotches on marginals nearest

the bridge with sharply defined c- or s-shaped light areas within them. Young with plates of carapace separated by depressed margins. For dorsal head pattern, see Fig. 1.

P. f. floridana.—Color: background of carapace black or very dark brown; markings on soft parts pale greenish yellow; plastron very dilute greenish yellow. Suture between costals and marginals without accessory parallel ridge or furrow; highest point of carapace well forward of middle of long axis. Plastron with anterior upward curve beginning at humero-pectoral suture, and posterior upward curve beginning on abdominals. Blotches on lower marginals without light figures within them. Young with dorsal plates imbricated. For dorsal head pattern, see Fig. 2.

The rather complex pattern on the sides of the head is very similar in the two races.

The characters given above, as well as those by which these forms have hitherto been separated, occur in every possible combination and degree of modification in northern Florida. I have never seen *floridana* in Alachua Co., and have seen typical *concinna* but twice. Eighty miles south, in Lake Co., I have seen only typical *floridana.*

Whether LeConte had the typical peninsular race when he described *floridana,* it is impossible to determine, either from the characters used or the type locality designated (St. Johns River).

Specimens examined:

P. f. floridana.—(by counties, FLORIDA) Orange 15, Pinellas 1, Citrus 1, Marion 8, Lake 40, Sarasota 8, Charlotte 1, Dade 1, Hendry 1.

P. f. concinna.—(by counties) Wake 3, Edgecombe 1, NORTH CAROLINA; Tift 2, GEORGIA; Leon 2, Alachua 2, FLORIDA.

Intergrades.—(by counties, FLORIDA) Levy 17, Alachua 25, Ockaloosa 1, Marion 10.

Acknowledgements.—For the loan of specimens I wish to thank Mr. C. S. Brimley, Raleigh, North Carolina, and Mr. T. Van Hyning, Curator of the Florida State Museum. To Dr. Leonhard Stejneger and Dr. A. H. Wright I am indebted for valuable suggestions.—A. F. CARR, JR., *Department of Biology, University of Florida, Gainesville, Florida.*

ON THE OCCURRENCE OF A PROBABLE HYBRID BETWEEN THE EASTERN AND WESTERN BOX TURTLES, *TERRAPENE CAROLINA* AND *T. ORNATA*, NEAR LAKE MAXINKUCKEE, INDIANA.—The range of the eastern box turtle is given by Stejneger and Barbour in their *Check List* (3rd ed., 1933), as "Eastern United States from Maine to Georgia, west to Tennessee, western Illinois, and northwards to central Michigan"; by Jordan, in the *Manual of the Vertebrates of the Northern United States* (13 ed., 1929) as "Me. to S. Mich., S. to Ga."; by Hay, in the *Indiana Geological Report for 1891* as from New England to the Gulf and westward to Texas; and by Ditmars in the *Reptile Book* as "New England States to South Carolina (inclusive) and westward to Kansas." Within its range, while not rare, it can nowhere be said to be common; one might stumble across a pair in a day's tramp. Its natural occurrence west of the Mississippi appears to be rather doubtful. It migrates but little and, though it has been seen swimming across creeks, any large stream would be an effective barrier to its distribution. Hay says of it that it lives for a long time, and does not wander.

The home of the western box turtle, *T. ornata*, appears to have been originally west of the Mississippi. It was first described from the Upper Missouri and Iowa. According to Hay, in the report above mentioned, it occurs abundantly west of the Missouri River, "being, as reported by F. W. Cragin 'so abundant in some sections of Southern Kansas, that it amounts to a nuisance as a cumberer of the ground.'" In the literature consulted nothing is said of its migrating habits. As however, migration is usually associated with pressure of population, it probably differs markedly in this respect from its congeners. It is a non-swimming species; and the Mississippi, until bridged, would prove a barrier to the eastward.

To the casual observer there is a marked resemblance between these turtles, especially since *carolina* is so variable in color pattern that no two individuals look very much alike. *T. ornata* is much more constant in color pattern.

The chief distinguishing characters of the two species consist in the presence of a keel ("young keeled, the keel growing obscure with age") in *carolina,* and the absence of a dorsal keel at any time in *ornata.* With the obscuration of the keel with age in *carolina* it will be observed that in aged individuals this distinguishing feature disappears.

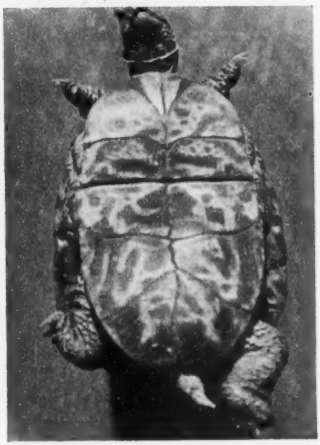
There are differences in color of the carapaces, but, as said above, those of *carolina* are notoriously variable, although they do not approach those of *ornata*.

The most striking and constant difference in the two species, however, is in the coloration of the plastron. That of *carolina* is without definite markings. It may be mostly yellow, mostly black or yellow with black freckle-like markings. One specimen examined had a sort of approach to a pattern by having all but the margin of the plastron black, the yellow of the margin encroaching in regular serrations, so that the *outline* was definite, but there was no ornamentation within the border.

The ornamentation of the plastron of *T. ornata* is highly developed, yellow lines on the dark background forming a pattern like that of a fancy rug.

Before 1891, *T. ornata* had ranged eastward into Illinois; Hay reporting that "some years ago specimens were sent to the National Museum from Fairfield, Wayne County, Illinois, within 35 miles of the Wabash River, hence its occurrence within Indiana territory may be discovered at any time."

It was not until 1923, however, that *ornata* was known to occur in Indiana. Among a number of turtles received at the opening of the Steinhart Aquarium, San Francisco, from Russell V. Fisher, of Culver, Indiana, in that year, were specimens of this species, and more were received in subsequent years; it seemed indeed to become more common than the native species. Its occurrence has already been reported upon. That it was a recent arrival is indicated by the fact that during the Lake Maxinkuckee Survey where intensive search was carried on in the region about the lake at intervals for about fourteen years, not a single example of this species was encountered.



At the time of the discovery of its presence within the Maxinkuckee region some speculation was indulged in regarding the result of this invasion. One possibility was that the newcomer might supplant the original inhabitant; another question that arose was whether, with barriers removed between them, there might not possibly ensue an admixture of the two species.

The latter event had already occurred, apparently before the observation that had given rise to the speculation; for on September 15, 1931, during a collecting trip about Lake Maxinkuckee, there was picked up in a field southwest of the lake what was undoubtedly a hybrid between the two species.

It is a medium-sized turtle, length of carapace 107 mm., of plastron 111 mm., the carapace highly arched, but flattish on top, its height about 47 mm. Toward the front of the carapace are faint indications of a keel. The coloration is as follows: Head: ground color blackish, irregularly splashed with yellow. Carapace: an interrupted yellow vertebral line with broken lines at sides of vertebral plates, costal plates not quite alike on opposite sides, those on the right side with broad yellow vertical bars in addition to spots, suggesting a radial arrangement, those on the left side more irregular, but still suggesting a radial arrangement; marginal plates mostly yellow in the center, with black lines at the border each side of the suture. About half of the coloring of the carapace is yellow. Plastron an irregular network of wide black lines on a yellowish ground, the black lines often anastomosing; broad black lines follow the sutures, and branch irregularly. (See fig.)

The specimen is a male, with brilliant red iris, the plastron slightly concave.

Most of the box turtles show, some faintly, some more distinctly, marks indicating growth rings on the scutes. The hybrid at hand has 9 of these, apparently indicating an age of 9 years. It is considerably larger than a specimen, possibly dwarfed, of *T. carolina* from the same region which shows 13 distinct growth lines.

On the same trip two large examples of *T. carolina* were found, both remarkable for

their color pattern. Each scute of the carapace is bordered by a distinct black line, the sutures all standing out in glaring distinctness—if black can be called glaring.

Many of the more conservative naturalists view with suspicion attempts to explain certain intermediate individuals as a result of hybridism between species, and in many cases it is difficult to check up by experiment. With the box turtles this should be easy, as the sexes can at all times be distinguished, the male having red eyes and a concave plastron, while these are absent in the females.

The eastward migration of the painted box turtle seems to be paralleled by a general eastward migration of numerous other forms. Butler, in his report on the *Birds of Indiana* (Indiana Geological Report for 1897) places in his hypothetical list a number of western birds that have appeared in Illinois, but for which no record had yet been given for Indiana. From vague reports of strange animals occasionally captured in Allen County, Indiana, it seems likely that the "striped gopher" *Citellus tridecemlineatus* has begun invading that country from further west.—H. WALTON CLARK, *California Academy of Sciences, San Francisco, California.*

AMPHIBIANS AND REPTILES OF THE NAVAHO COUNTRY.—Although not rich, the herpetological fauna of northeastern Arizona and southeastern Utah has not been described hitherto, and the distribution and relative abundance of many species are therefore worth recording. In the summer of 1933 the writer collected the species listed here on an expedition through the Navaho country, under Ansel F. Hall of the National Park Service. The specimens are deposited in the Museum of Vertebrate Zoology in Berkeley, California.

1. *Ambystoma tigrinum* Green.—One seen in a well at Kayenta, Arizona.

2. *Scaphiopus hammondii* Baird.—Five males taken between Kayenta and Rainbow Lodge, Arizona. Larvae found abundantly in canyon pools in the same area, as well as in Rainbow Bridge Canyon, San Juan County, Utah. Such pools, however, were usually miles apart.

3. *Bufo cognatus* (Say).—One female, between Tuba City and Kayenta, Arizona.

4. *Bufo punctatus* Baird and Girard.—Abundant in pools at Rainbow Lodge, Arizona, in early July. Many adults and small transformed specimens found in canyons near Rainbow Bridge.

5. *Bufo woodhousii* Girard.—Common from Kayenta to Rainbow Lodge, Arizona, but less abundant locally than *punctatus*.

6. *Hyla arenicolor* Cope.—Found calling in Grand Canyon on June 7 and at Rainbow Lodge on July 5. Numerous in both places near water, but seen nowhere else.

7. *Rana pipiens* Schreber.—One specimen from Rainbow Bridge, San Juan County, Utah, is a normal *pipiens*, but a second, from Goodridge, Utah, on the San Juan River, shows a reduction of spots, as in *onca* Cope. The great variability of *pipiens* in the southwest, appears ample reason for doubting the validity of *onca*, since numerous intermediates occur.

8. *Crotaphytus collaris baileyi* (Stejneger).—Not found above 6,000 ft. except at Rainbow Lodge (6,500 ft.) where the slope is southward and it was very common. It does not occur on the mesas eastward.

9. *Crotaphytus wislizenii* Baird and Girard.—One found in Chinle Canyon, San Juan County, Utah. Evidently the species can be expected anywhere in the valley of the San Juan.

10. *Holbrookia maculata approximans* (Baird).—Abundant on open sand at Kayenta (Lower Sonoran).

11. *Uta ornata symmetrica* (Baird).—Common about cliffs and ledges in the Upper Sonoran canyons west of Kayenta.

12. *Uta stansburiana stansburiana* Baird and Girard.—About as abundant as the preceding, in the same localities.

13. *Sceloporus elongatus* Stejneger.—Most abundant in Upper Sonoran canyons from near Kayenta, Arizona, to Dunn's Trading Post, San Juan County, Utah. Occasional on the mesa tops (Transition), at 7500 ft. Restricted to boulders, ledges, and trees.

14. *Sceloporus graciosus graciosus* (Baird and Girard).—The most common and variable lizard in the region. Taken from 5800 to 9500 ft. elevation (through Upper Sonoran and Transition zones). There is a general increase in size of scales, darkening

of color, and obliteration of pattern with increase in altitude. One specimen, from Dogoszhee Canyon, near Kayenta, combines the characteristics of *S. elongatus* (no stripes; keeled scales on back of thighs) with those of *S. g. graciosus* (15 femoral pores).

15. *Sceloporus magister* Hallowell.—Taken at Cameron, Coconino County, and vicinity of Kayenta, Navaho County. Scarce, and limited by preference to pine scrub.

16. *Phrynosoma douglassii* (Bell).—Taken at Tuba City, Coconino County, and Kayenta, Navaho County, Arizona; and Dunn's Trading Post, San Juan County, Utah; in all five specimens. Distinction between the subspecies *ornatissimum* and *hernandesi* has proved baffling. Characters of the two are mingled in this region.

17. *Cnemidophorus sexlineatus sackii* (Wiegmann).—Taken at Tuba City, Kayenta and Rainbow Lodge, Arizona. Upper Sonoran, in sandy areas. Burt has recently[1] given good evidence for synonymizing *C. sexlineatus gularis* (Baird and Girard) with *C. sackii* Wiegmann, which has priority.

18. *Masticophis* (*Coluber*) *taeniatus taeniatus* (Hallowell).—Taken in Piute Canyon, Navaho County, and at Rainbow Lodge, Arizona.

19. *Pituophis catenifer deserticola* Stejneger.—Four specimens, at Kayenta, Arizona, and in canyons westward.

20. *Thamnophis ordinoides vagrans* (Baird and Girard).—One immature specimen at Goodridge, San Juan County, Utah. Lower Sonoran.

21. *Crotalus confluentus confluentus* (Say).—Two specimens taken at Marsh Pass, 12 miles southwest of Kayenta, Arizona, and one from Dunn's Trading Post, San Juan County, Utah, are transitional towards *C. c. lutosus*. A fourth, from Alkali Mesa, east of Blanding, Utah, varies strongly towards *C. c. concolor*, but, according to Mr. L. M. Klauber, who now has the specimens, it is still to be considered *confluentus*. The Navaho region therefore seems to be a meeting place of three subspecies, and further collecting would be valuable.—THEODORE H. EATON, JR., *Wild Life Division, National Park Service, Berkeley, California.*

COLOR VARIATION IN THE COAST GOPHER SNAKE.—A gopher snake showing an unusual coloration was picked up on the Carmel Valley highway, Monterey Co., California, on May 15, 1933. It was identified as *Pituophis catenifer catenifer* (Blainville).

This individual instead of having a large series of more or less irregularly shaped blotches, which is the usual condition, has a series of nine longitudinal bands of evenly blended pastel tones of cream to brown, light and dark alternating. There is not the slightest indication of blotching as the bands remain relatively uniform in width and color throughout the length of the specimen.

In general appearance the head is dorsally a dark tan blending into a relatively darker brown characteristic of the dorsal side of this individual. The supralabials and the scales along the ventral edge of the eye, like those of the lower jaw and throat, are of a creamy-white typical of the coloration of the ventral surface.

The color pattern in the anterior part is given from the most lateral left to the most lateral right row of dorsal scales.

3 rows of cream scales
3 rows of cream scales with large brownish centers
3 rows of cream-tan with tiny dots of black peppered in the surrounding skin
5 rows of light chocolate brown with occasional tiny black dots
Midline—1 row of light brown, slightly lighter than preceding band
5 rows of light chocolate brown with occasional tiny black dots
3 rows of creamy-tan with tiny black dots in the surrounding skin
3 rows of cream scales with large brownish centers
3 rows of cream scales.

The posterior part of the body shows the same general proportion of color, same tones, and also same arrangement. The reduction in the number of scale rows does not affect the color pattern. Toward the tail there is a noticeable increase in the amount of black pigment, which appears to be mainly deposited at the bases of the scales in the mid-dorsal line and some in the first line to the right and to the left of this mid-dorsal line. The amount of black in the midline increases gradually from about the middle of the body posteriorly to the tip of the tail. On the tail it forms three ragged and very narrow dark lines almost to the tip, the center line continuing to the very tip. This small amount of black is not of sufficient quantity to be conspicuous in the general color scheme.

[1] Burt, C. E., The status of the spotted race-runner, *Cnemidophorus sexlineatus gularis* (Baird and Girard). *Proc. Biol. Soc. Wash.*, 44, 1931: 73-78.

Small dark brown or black pigment patches occur on the lateral and posterior edges of almost all of the gastrosteges. These small patches of color are irregular in distribution and intensity of tone in the anterior region, and more definite in distribution and of a more uniform size posteriorly, although the variation continues posteriorly. There is an occasional peppering of black dots along the ventral edge of the more posterior of the gastrosteges, and very tiny dots on the ventral edges of some of the urosteges.

The scutellation shows some variation although it is still within the range for the species: supralabials, 9–7; infralabials, 12–11; gastrosteges, 216; urosteges, 73; dorsal scale rows, 29. The last gastrostege or anal plate is undivided, while the first post-anal urostege is formed of four parts, two long lateral scales and two small central scales. The remaining urosteges present the normal arrangement of two parts. This specimen is an adult male.

There is, no doubt, very little if any correlation between the change in color pattern and the variation in the number of scales. A point of interest, however, is whether other gopher snakes without spots occur within this same region, and whether they are forming a new type.—EDNA M. FISHER, *Berkeley, California.*

A PRELIMINARY LIST OF MINNESOTA AMPHIBIANS.—Since very little work has been done on Minnesota amphibians, and no faunal list of the amphibians of the state has appeared in the literature it seems desirable to place on record the following notes. They are based chiefly on the collections of the Department of Zoology and of the Museum of Natural History, University of Minnesota, with some additional records from the field notes of the writer. I am indebted to Mr. George W. Friedrich of the State Teachers College at St. Cloud, to Mrs. Helen T. Gaige of the University of Michigan Museum of Zoology, and to Mr. Karl P. Schmidt of the Field Museum for permission to use the records of Minnesota amphibians in the collections of their respective institutions.

It is a pleasure to express my appreciation to Mr. M. Graham Netting, Mr. Karl P. Schmidt, Dr. Charles F. Walker, and Mrs. Helen T. Gaige for examining material sent to them, to Dr. E. R. Dunn for the use of his records of *Ambystoma tigrinum*, and to Dr. Samuel Eddy for permission to use his own records and those of the Department of Zoology at this university.

So little field work has been done in the state that this list is admittedly incomplete in many respects. It is certain that additional species will be added when more extensive collecting has been carried on. For example, we have no Minnesota specimens of the bullfrog and no records of the cricket frog, two species which will undoubtedly be found to occur regularly in some part of the state. There are doubtless others as well.

1. *Necturus maculosus* (Rafinesque)

The mud puppy is widely distributed in Minnesota, and is probably more common than our records would indicate. The specimens in the collections of the university are from the Minnesota River below Shakopee (Scott, Dakota counties). Mr. Friedrich has taken it from the Snake River near Mora (Kanabec Co.), and from the outlet of Ottertail Lake (Ottertail Co.). Some thirty years ago, when the Mississippi River in the Twin City region was not so polluted with sewage as at present, this species was common in the river, and the specimens used in the Comparative Anatomy classes were obtained there. Dr. C. P. Sigerfoos reports that the specimens were brought to him in numbers up to 40 or 50 from the river near Minnehaha Park. The species has been reported to the writer from the St. Croix River near Taylor's Falls (Chisago Co.), and from the Mississippi River near Fridley (Anoka Co.). Over (1923) records it from Big Stone Lake, which borders Big Stone County in western Minnesota, and Cope (1889) reports a specimen from Isle Royale, which is less than 25 miles from Minnesota.

2. *Triturus viridescens viridescens* (Rafinesque)

The newt has been taken in Minnesota but twice, according to our records. Two specimens in the Museum of Zoology, University of Michigan, were taken in 1917 at Lake Minnetonka (Hennepin Co.), and a single specimen in the Zoology Department collection at Minnesota was taken at Itasca Park, Clearwater Co., in 1934.

3. *Ambystoma jeffersonianum* (Green)

Jefferson's salamander does not appear to be abundant, but it has been taken from a number of widely separated localities. Specimens have been seen from Minneapolis and Lake Minnetonka in Hennepin Co., Itasca Park in Clearwater Co., Ely in St. Louis

Co. (Harry Adams), and from Rocky Point, Lake of the Woods Co. (P. O. Fryklund).

The specimens are usually found under mossy, rotting logs which have remained undisturbed for some time. At Lake Minnetonka and Itasca Park they were taken chiefly in a heavy growth of maple forest, which seems to be a particularly favorable environment. They were also taken in heavy stands of pine at Ely and Itasca Park. Strangely, the Minnesota specimens have all been smaller than full grown specimens from the east.

4. *Ambystoma tigrinum* (Green)

The tiger salamander is common throughout the state. There are specimens in the collections from Minneapolis (Hennepin Co.), Fertile (Polk Co.), and Gull Lake (Cass Co.). In addition it has been seen commonly in Fillmore Co. In the course of his studies on the ambystomas Dr. Dunn has seen specimens from Elk River (Sherburne Co.), Fort Ripley (Crow Wing Co.), Island Lake (Lyon Co.), Lac-qui-Parle (between Lac-qui-parle and Chippewa counties), and several specimens from Hennepin Co. Mr. Friedrich has taken it in the St. Cloud area (Stearns Co.).

5. *Plethodon cinereus* (Green)

Dr. Eddy has seen this species in Pine Co. and Mr. Harry Adams reported taking one individual near Ely, in St. Louis Co., but no specimens were preserved. There are many specimens in the collection from St. Croix Falls, Wisconsin, however, just across the river from Minnesota, and undoubtedly it occurs all along the St. Croix Valley. Cope (1889) reports two specimens from "Lake Superior," and three from Fort William, Lake Superior, in Ontario. The latter locality is less than 50 miles from the northeastern tip of Minnesota.

6. *Bufo americanus americanus* Holbrook

The common toad is abundant throughout the state. Occasionally specimens are taken which markedly resemble *Bufo fowleri*, but Mr. Netting has studied a number of these specimens, and none has proved definitely to be *B. fowleri*. Minnesota is well out of the range of Fowler's toad, and probably has no other species of toad than *B. a. americanus*.

7. *Pseudacris nigrita triseriata* (Wied)

The swamp tree frog is our commonest tree frog, undoubtedly found throughout the state. The specimens examined have been from the following counties: Clearwater (Itasca Park), Washington, Ramsey, Hennepin, and Fillmore. Mr. Friedrich has specimens from Rockville and St. Cloud in Stearns Co., and from Robbinsdale in Hennepin Co.

The Minnesota specimens of *Pseudacris* are not typical *P. n. triseriata*, but are intergrades approaching *P. n. septentrionalis* (Boulenger). Pending the appearance of Walker's forthcoming revision of the genus, however, it seems wiser to call them all *P. n. triseriata*. The Wrights (1933) include Minnesota in their statement of the range of *P. n. septentrionalis*, and mention specifically specimens taken at Pembina, North Dakota, which is just across the Red River from the northwestern corner of Minnesota.

8. *Hyla crucifer* Wied

The spring peeper is common and widely distributed in the state. Specimens have been examined from Fillmore, Hennepin, Clearwater, and Goodhue counties.

9. *Hyla versicolor* (Le Conte)

The common tree frog is also widely distributed and abundant in Minnesota. There are specimens in the collections from lower Red Lake, Frontenac (Goodhue Co.), Lake Minnetonka (Hennepin Co.), and Karlstad (Kittson Co.). In addition it has been seen from Pine Co. at Sturgeon Lake. Mr. Friedrich has specimens taken at St. Cloud, and the Field Museum has specimens collected by D. D. Davis at Hokah, Houston Co. Cope (1889) has assigned a specimen from Gull Lake, Brainerd, Minnesota, to his *Hyla versicolor phaeocrypta* which is not now recognized.

10. *Rana cantabrigensis* Baird

Wherever suitable forested places occur in the state this wood-frog is found, especially in the climax maple-forests. Specimens in the collections are from Hennepin Co. at Minneapolis, Anoka Co. at Fridley, Washington Co. at Stillwater, Clearwater Co. at Itasca Park, and Koochiching Co. near Ericsburg. It has been observed frequently in Itasca Co. as well. Cope (1889) reports specimens from Lake Winnibigoshish, Mr. Friedrich finds the species at St. Cloud, the Field Museum has specimens taken by D. D. Davis at Hokah, Houston Co., and the University of Michigan Museum of Zoology has a specimen from Osage, Becker Co.

11. *Rana catesbeiana* Shaw

We have no specimens of the bullfrog from Minnesota, but Dr. T. S. Roberts has seen and heard the species in the flooded lowlands of the Minnesota River near the Long Meadow Gun Club, south of Minneapolis. This was in the summer of 1902; whether or not this frog is still present there we have not been able to determine, but it will undoubtedly be found in other parts of the state. In recent years there have been several reports of the occurrence of the bullfrog in the bottomlands of the Mississippi River below Lake Pepin, but as yet none of these has been substantiated with specimens.

12. *Rana clamitans* Latreille

The green frog does not appear to be abundant, but it is widely distributed in the state. The specimens examined were taken at Fridley (Anoka Co.), Eveleth (St. Louis Co.), Stillwater (Washington Co.), "Disbach" (probably Dresbach, Winona Co.), and at Gull Lake (Cass Co.). Mr. Friedrich has specimens from Stearns Co., and from Sherburne Co. at Elk River; the Field Museum has specimens taken by D. D. Davis at Hokah, Houston Co., and the Michigan Museum of Zoology has specimens from Goodhue and Hennepin counties.

13. *Rana palustris* Le Conte

Our only record of the pickerel frog is a single specimen taken by D. D. Davis at Hokah, Houston Co., in June, 1931. This specimen is in the Field Museum collections.

14. *Rana pipiens* Schreber

The leopard frog is abundant throughout the state in its normal color phase. In the colorations described by Weed (1922) under the names *R. burnsi* and *R. kandiyohi* its distribution is apparently limited. The immaculate form (*burnsi*) Weed reports from Kandiyohi, Wilkin, and Jackson counties, all in the western part of the state, and the Wrights (1933) found it also in Kandiyohi Co. It also occurs in the Minneapolis region, some lots of frogs exhibiting this color variation in over 10% of the individuals, though the average is nearer 5%. The vermiculated form *(kandiyohi)* Weed reports from Kandiyohi and Wilkin counties. It has not been noted in the Minneapolis region.

15. *Rana septentrionalis* Baird

The type locality of the mink frog is "northern Minnesota." The specimens in the collections are from Eveleth, St. Louis Co., and from Itasca Park, where it is especially abundant. Cope (1889) reports a specimen from Fort Ripley, in Crow Wing Co. Mr. W. J. Breckenridge has three specimens taken by him at Holt Lake, just north of Mille Lacs (Aitkin Co.), and Mr. Friedrich has taken it at Lake Shemahgon, near Red Lake.

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GUSTAV SWANSON, *Department of Conservation, Minneapolis, Minnesota.*

NOTES ON *CROTALUS ATROX* NEAR TUCSON, ARIZONA, WITH SPECIAL REFERENCE TO ITS BREEDING HABITS.—On August 4, 1930, Kenneth Hobbs, then of the United States Biological Survey party, found a large *Crotalus atrox*, that is, large for the vicinity of Tucson, Arizona. The snake was found on the Santa Rita Experimental Range, 35 miles south of Tucson. Its weight was 6 pounds on an ordinary spring balance, its length 55½ inches (1410 mm.).

Four days later, August 8, 1930, Hobbs brought in a moderate-sized rattler 37 inches (960 mm.) long, which, on dissection proved to contain 18 young nearly ready for delivery. There were 12 embryos on one side, 6 on the other. The length of one of the embryos was 10¼ inches (260 mm.).

On August 19, 1930, David M. Gorsuch of the Gambel Quail Investigation, University of Arizona, found a pair of *Crotalus atrox* copulating. The time was about 6:30 to 7:00 P.M. The snakes were under a mesquite in some rather arid barrens not far from the foothills of the Santa Rita Mountains.

The large rattler, in this instance evidently the male, had its body completely around that of the female. The latter was rather tightly coiled, and so completely covered by the male that it was hard to catch sight of her head. When the writer first saw the pair, they appeared to be in coitus, the male having his tail rather tightly coiled about that of the female in a clockwise direction. The tail of the female was held nearly perpendicular.

Reptile-like, they seemed to take matters calmly, paying little or no attention to three onlookers. At intervals the male appeared to feel over the body of the female with its tongue. The male moved its head with quick, short jerks. When locked in the sexual embrace, at intervals a tremor was seen to run through the entire body of the male. The female was apparently in orgasm, as the evident intromissions of the male were reflected in a contraction of her body. On one occasion Gorsuch saw the female break away before we arrived. The male was on her in an instant, holding and confining her with his larger, longer and stronger body. We also saw the copulating snakes break apart. The male appeared perturbed, and nervously felt about with its tail, trying to effect a connection. This time the female did not attempt to escape. Throughout the entire process the male took the initiative, the female playing a passive role.

A difference in snake disposition was exhibited when we captured the snakes alive. The female did not try to run away from us, but was caught with ease and placed in a wire cage. The male tried vigorously to escape, fought hard when prevented from doing so, and rattled much more than the female.

Dr. Charles T. Vorhies kept the female at the University of Arizona for months in the hope that fertilization had been effected and that the length of the period of gestation could be determined; but unfortunately without result.

Professor A. A. Nichol of the University of Arizona has observed *Crotalus atrox* copulating in the snake pits at the University during the month of May. The writer has one record of a copulation reported observed near Tucson in September, but cannot be sure to which species it belongs. It is not improbable, therefore, that mating takes place at least from May to September in this neighborhood. The observed mating recorded in this paper was not in the heat of the day, but rather the evening twilight of a hot summer day. All the matings that have come to the attention of the writer have been in pairs rather than in tight balls composed of many snakes, as reported by Geyer, Audubon, and Mills (see Wood, COPEIA, 2, 1933: 86), probably on an uncritical basis.—WALTER P. TAYLOR, *U. S. Biological Survey, University of Arizona, Tucson, Arizona.*

TAIL REGENERATION IN *COLEONYX BREVIS* STEJNEGER.—The observations on *Coleonyx variegatus* by Derbonne (COPEIA, 4, 1934: 191) closely parallel my own on *C. brevis*. The present article is offered mainly for its notations on the regeneration of the tail of the latter lizard.

On March 28, 1932, two specimens of *C. brevis* were taken in the Lower Rio Grande Valley about 25 miles west of Edinburg, Texas, in rolling rocky country. Feces examination indicated a diet of small Diptera and Coleoptera. Of this pair, the female deposited a solitary egg on April 7. This egg was capsule-shaped, cream-colored, and with a soft leathery covering.

On April 2, three more of these lizards were taken from the same locality and on April 12, one of the females deposited a single egg similar to the first one. Four of these five lizards averaged a total length of 70 mm. The fifth had some time previously lost most of its tail and a reddish conical stub 4 mm. in length had developed. Subsequent measurements of the regenerating tail were taken and are presented in the following table:

April 3	4.0 mm.	4	23.2 mm.
7	10.0 mm.	9	24.8 mm.
10	13.0 mm.	11	25.5 mm.
15	13.5 mm.	13	26.6 mm.
23	19.5 mm.	17	27.2 mm.
27	20.0 mm.	June 10	29.6 mm.
May 1	21.5 mm.	Nov. 7	30.3 mm.

Though no data were secured as to when the tail was lost, the time required to show first growth, nor the time taken to develop the 4 mm., these were furnished by another lizard which accidentally lost its tail on May 3. Observations were made during the next two weeks, but only a healing process was carried out. On May 17 a growth of 1 mm. was recorded. From that date on growth was rapid, though other duties prevented making of measurements until June 10 when a growth of 12 mm. was recorded.

Apparently the two weeks required in starting growth was due to readjustment necessary after the shock of forceful pruning, and to the need of developing of an entire cutaneous structure over the injured area. When that was completed, growth was started and carried on rapidly. The color pattern originally found in the tails is a continuation of the general color pattern of the body, but is not reproduced in the regenerated portion. For more than a month after new growth commences, the general color is a dark salmon with no pattern noticeable. In the specimen under observation the final color pattern did not begin to show until April 27. After this time faint indications of spots began to appear and enlarge until the salmon colored tail was covered with numerous squarish dark slate-colored spots.

It was noticed in these lizards that when the food supply was abundant, the tails became considerably enlarged and thickened, whereas during periods of food shortage, the excess tissue was used up. In conclusion it may be stated that the rate of tail regeneration is much more rapid in *C. brevis* than in such lizards as *Sceloporus torquatus cyanogenys, S. spinosus floridanus* and *Eumeces* which have come under my observation. —STANLEY MULAIK, *Edinburg, Texas.*

ON THE INCUBATION OF A CLUTCH OF EGGS OF *AMYDA FEROX* (SCHNEIDER).—At eleven o'clock in the morning on May 19, 1931, a large turtle, *Amyda ferox*, was found at about 25 yards distance from the western shore of Lake Griffin, Lake County, Florida, crawling toward a cleared area within the hammock.

The turtle was captured and weighed, her weight being 14,159 gm., or 31¼ lbs. Two days later she was killed, and 20 eggs complete with shells and many other incomplete ones were removed from her body. The eggs which were ready to be laid were white, spherical, and hard-shelled, had an average diameter of 25 mm., and an average weight of 12 gms. These eggs were buried in the sandy soil at a depth averaging 3 to 5 inches. Subsequently single eggs were removed from the clutch and the state of development in the embryo was noted. The following table indicates the number of days of post depositional incubation, length of the embryo on dates examined, and soil temperatures which were taken in a similar place at no great distance from the buried eggs.

Date of examination	Duration of incubation	Length of embryo in mm.	Average temperature in degrees Fahrenheit
May 31	10 days	6.0	82.3 May 21 to May 30
June 11	21 "	9.0	85.7 May 31 to June 10
June 16	26 "	10.0	85.8 June 11 to June 15
June 21	31 "	13.0	85.0 June 16 to June 20
June 30	40 "	20.0	89.2 June 21 to June 29
July 10	50 "	34.0	88.0 June 30 to July 9
July 15	55 "	35.0	85.2 July 10 to July 14
July 20	60 "	37.0	88.0 July 15 to July 19
July 29 (hatched)	64 "	50.0	89.2 July 20 to July 29

The first embryo, examined on May 31, was soft, colorless, much curved and had a large head. The limb buds were visible and there was a faint indication of a carapace. The second embryo, examined on June 11, had a very distinct carapace. In other respects both this and the one examined on June 16 resembled the first. The egg opened on June 21 bared an embryo with a distinct snout and showed the structure of the digits. Like the ones previously examined this one was also colorless. But the embryo examined on June 30 had distinct dark blotches on the carapace. Subsequent examinations revealed embryos little different from those that were eventually hatched. From June 30 on there was a rapid diminution of the size of the yolk sac. Three of the eggs did not develop; with the exception of those examined, the rest hatched on July 29.

The newly hatched turtles averaged 8.82 gms., the largest weighing 9.25 gms., and the smallest 8.50 gms. The head, neck, and limbs were greyish black streaked with yellow. The plastron was a solid greyish black with a distinct mark indicating the location of the umbilicus. The color pattern of the carapace dorsally consisted of dark, quite regular blotches on a lighter ground color; the edge of the carapace was a solid yellow, and its under surface in the posterior region was yellow with black irregular blotches.

The embryos and the turtles preserved at the time of hatching are in the Museum of Zoology, University of Michigan, Nos. 76754–76756.—DOROTHY S. GOFF and C. C. GOFF, *University of Florida, Field Laboratory, Leesburg, Florida.*

Reviews and Comments

EXOTIC AQUARIUM FISHES. A Work of General Reference. By William T. Innes. Innes Publishing Co., Philadelphia, 1935: 1-466, 2 maps, 41 col. figs., 267 half-tones, 34 line figs. $5.00—The author, the illustrator, the editor, the publisher and the printer have all concentrated their efforts on this long awaited aquarium book; and all these are William T. Innes. With the splendid spirit which moved the vanishing tribe of master craftsmen to perfect their products, genial "Bill" Innes, as this leading sponsor of the hobby is known to thousands of aquarium fish enthusiasts, has spared neither time nor money, neither energy nor enthusiasm, in preparing *Exotic Aquarium Fishes*. From cover to cover, literally, he has given attention to everything which goes to make a fine book, from the major plan of organization, selection of material, and method of presentation, down to the choice of paper stock, the reproduction of each illustration and the typographical details of every page. The 344 illustrations are new, or taken from the author's magazine *The Aquarium*, and are uniformly excellent reproductions of his own masterful photographs, 41 in true colors, supplemented by clear line figures.

Virtually all species treated are illustrated, so well that long descriptions are not needed. The species "writeups," below each figure, are generally brief; in spots a bit racy; nowhere padded; expanded only when interesting features, especially of breeding habits, truly call for the extra space.

Two location maps are indexed to locate the native habitat of each species treated in the text. The distribution of each main family of aquarium fishes is also mapped. The high standard of accuracy characterizing this book may be traced not only to the long experience and care of the author, but also to the acknowledged services of Dr. George S. Myers of the National Museum.—Carl L. Hubbs, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

NATURAL HISTORY OF VERTEBRATES (EXCEPT BIRDS), A LABORATORY AND FIELD GUIDE. (Revised). By Frank N. Blanchard. Ann Arbor. Edwards Bros., 1935: ii+82 pp. Students and teachers of vertebrate zoology have been provided with a most useful aid in the revised edition of Dr. Blanchard's laboratory and field guide for natural history of the vertebrates. It is planned with the objective of giving the student direct contact with the several methods of approach to a knowledge of the natural history of animals. Field and laboratory work, the use of original sources in the literature, and their correlation with the lectures of the instructor are emphasized. With the exception of the birds, all the vertebrate classes are treated under the following headings: (1) classification, with tabulation of the characteristics, examples and distribution of the principal groups, and a number of carefully chosen references; (2) directions for laboratory work involving study of specimens and literature; (3) special problems in field work; and (4) an inclusive list of references for the group. A brief account of methods of collecting and preserving vertebrate animals for study, with references to more complete treatments of the subject, is given in a section immediately following the introduction. A number of sheets bearing an outline of the important topics in the study of a species and a small base map of North America for indicating the range are provided to facilitate the organization of laboratory notes made by the student. The pages of directions for field problems are supplied in duplicate so that one copy may be carried in the field and the other, unsoiled, retained in the notebook. In the sections on Amphibia and Reptilia, keys for the identification of Michigan species are included. The field exercises are also based upon local forms for the guide is intended primarily for the use of classes at the University of Michigan. With these exceptions the salient features of the book are of world-wide scope and there is no regional emphasis. With minor adaptations to suit local needs this guide can be used effectively in any section of the country. It is lithoprinted, loose-leaf, and punched for the standard three-ring 8½ x 11 notebook cover.—H. K. Gloyd, *Zoological Laboratory, University of Michigan, Ann Arbor, Michigan.*

A MANUAL OF LAND AND FRESH WATER VERTEBRATE ANIMALS OF THE UNITED STATES (EXCLUSIVE OF BIRDS). 2nd Edition. By Henry Sherring Pratt. P. Blakiston's Son & Co., Inc., Philadelphia, 1935, i-xvii, 1-416, figs. 1-184, 1 col. map. $6.00—Now that David Starr Jordan's *Manual of the Vertebrates* has presumably reached its last edition, Professor Pratt's *Manual* should carry on, as a prime stimulation and guide to natural history studies in North America. This being the book's responsibility, it should be made a usable and adequate means for identifying the vertebrates (other than birds) of the wide area it covers, and should be kept as up-to-date in matters of nomenclature and fact, as economies in printing allow. These ideals are more nearly attained for the amphibians and reptiles, and perhaps for the mammals, than for the fishes. "Dr. Emmitt Reid Dunn, Professor of Biology in Haverford College and the author's colleague, has thoroughly revised the sections on Amphibians and Reptiles." Herpetologists remark, however, that the modernization of these sections has been somewhat haphazard.

The section on fishes in many parts is unsatisfactory, very often inadequate for identification even by a trained ichthyologist, and definitely not up-to-date. Two- or three-line descriptions, a few of at most 8 to 10 lines often containing non-diagnostic characters and natural history notes, can hardly be made adequate for identifying closely related freshwater fishes. If longer accounts are prohibited by the limits of such a book, then separate manuals for each group are called for. Furthermore, no one but a specialist can hope to prepare a workable manual to our freshwater fishes. The reviser of the fish section of the first edition had not worked critically on these fishes for almost a generation; nor had Dr. Jordan, whose last Manual (1929), along with Jordan, Evermann, and Clark's Check-list (1930), was used as the basis for the revision of the fish section in the second edition of Dr. Pratt's Manual.

To be sure the reviewer is twice given indirect credit for revising the present work, in that he is accredited with revising Dr. Jordan's last *Manual,* which was used in correcting Dr. Pratt's. The reviewer, however, must disclaim responsibility for the numerous errors and the obviously or apparently unjustified or unhappy systematic conclusions which mar both of these manuals and the 1930 check list as well. He is particularly opposed to the breaking down of *Notropis* and *Poecilichthys,* at least until careful revisionary studies replacing a mere instinct to split on the basis of inadequate previous data, provides a satisfactory basis for keying out the segregated genera. The treatment of the *Notropis* complex in the three works cited is a travesty.

Most of the keys to genera and species are hopelessly simplified, often with a poor choice or even a false statement of alternative characters. One key, for a horrible example, distinguishes coarse-scaled suckers wholly on the basis of distribution, with glaring errors both of omission and placement. In the fish section alone, the subspecies as listed consistently do not include the typical subspecies. Typographical errors are too evident, and the type composition is not ideal though the printing is good. A glaring error repeated from the first edition, despite the fact that it was pointed out to the author, is the labelling of a figure of *Petromyzon unicolor* [= *marinus*] as *Reighardina unicolor* [= *Ichthyomyzon fossor*.]

An outstanding and inexcusable fault of this manual is the failure to include any of the new forms of fishes described since 1928. One family, three genera and approximately fifty valid species and subspecies described from 1927 to 1933 are omitted. Though the list as given includes some synonyms, it is not more than 80% complete.

One is lead to wonder what is the function of such a general manual of our vertebrates. It certainly is not used by specialists. At least as it stands, particularly for fishes, the work is inadequate for building up local lists, or for making any certain identifications. It is very convenient for class room use, but should the student be allowed to use so simplified a treatise, to absorb the idea that identification is so easy, and to perpetuate the subjective methods of taxonomy which necessarily are involved in identifying animals from such terse keys and diagnoses?

Many features of Pratt's Manual are very commendable, especially from a pedagogical viewpoint. It is to be hoped that the next edition will include a real revision of the fish section.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

EDITORIAL NOTES AND NEWS

Meeting of Western Division

THE seventh annual meeting of the WESTERN DIVISION of the American Society of Ichthyologists and Herpetologists was again held during the sessions of the Pacific Division of the American Association for the Advancement of Science. This meeting, held in June at the University of California at Los Angeles, Los Angeles, California, was attended by about 30 members and guests, and was presided over by L. M. KLAUBER. The Nominating Committee (C. M. Bogert, Edna K. Fisher and R. B. Cowles) presented the names of the following for officers for the ensuing year: *President*, SARAH ATSATT, Zoology Department, University of California at Los Angeles; *Vice-President*, ROLPH BOLIN, Hopkins Marine Laboratory, Monterey, California; *Secretary-Treasurer*, ARTHUR SVIHLA, Washington State College, Pullman, Washington. It was moved and seconded that the Secretary be instructed to cast a unanimous ballot for the nominees. The motion was carried. Subsequent to the business meeting the following papers were presented:

1. **The Breeding Habits of the Chub, Mylocheilus caurinus (Richardson) (Cyprinidae).**—Leonard P. Schultz.
2. **The Growth of the Pacific Rattlesnake.**—L. M. Klauber.
3. **Sand Dune Reptiles of Baja California, and the Problem of Convergent Evolution.**—Walter Mosauer.
4. **The Toleration of Solar Heat by Desert Reptiles.**—Walter Mosauer.
5. **The Derivation and Relationship of Flying Fish.**—Theodore H. Eaton, Jr.
6. **The Vital Limit of Exsiccation of Amphibia.**—Arthur Svihla.
7. **Intergradation in the Genus Salvadora and its bearing on the Phylogeny of the Genus.**—C. M. Bogert.
8. **On Mesimisgurnus, Gen. Nov. and Paramisgurnus Sauvage, with Descriptions of Three Rarely Known Species, and Synopsis to Chinese Cobitoid Genera.**—P. W. Fang.
9. **Color Change and Color Mechanism in Reptiles.**—Sarah Atsatt.
10. **Illustrations of Southern California Reptiles.**—R. B. Cowles.

An exhibit of living reptiles and amphibians, prepared by C. M. Bogert, L. M. Klauber and R. B. Cowles, was placed on view.

Membership in Society

SECRETARY M. GRAHAM NETTING has prepared a mimeographed list, geographically arranged, of the members of our Society, and will send this list to those wishing to know of fellow members in their own or some other region. This list will indicate names of many men and women, interested in ichthyology, herpetology or general natural history, who are not now affiliated with the Society. The Secretary suggests that such persons be nominated for membership.

News of Herpetologists

IT is with regret that we record the death on August 8 of FRANK J. W. SCHMIDT, a member of the Wisconsin Department of Conservation. Mr. Schmidt, a gifted young zoologist of great promise, was known herpetologically for his work with Dr. Sherman Bishop on the genus *Chrysemys*, and for his explorations with his brother, Karl P. Schmidt, in Guatemala.

Dr. CORNELIUS DEVILLIERS, of the University of Stellenbosch, South Africa, noted for his researches on the cranial anatomy of amphibians, is delivering a series of Carnegie lectures in Albuquerque, Los Angeles, Oregon and Harvard University.

Dr. FRANK N. BLANCHARD has received a grant from the Faculty Research Fund of the University of Michigan for the collecting of critical material, the visiting of habitats and the study of museum collections in the Southwest. He left in August for a five months trip, accompanied by HOWARD K. GLOYD.

CHANG TSO-KAN of the College of Natural Science of Yenching University, has received a $500 grant from the China Foundation, for herpetological researches in Kiangsi and Chekiang.

Ichthyological News Items

ICHTHYOLOGISTS learn with great regret that Dr. ALBERT EIDE PARR of Yale University, Director of the Bingham Oceanographic Laboratory, has been stricken with polyomyelitis. The last word cheeringly indicates recovery without paralysis. Dr. Parr is being cared for at the New Haven Hospital, New Haven, Connecticut.

Dr. WILLIAM CONVERSE KENDALL, until his recent retirement an almost life-long member of the scientific staff of the United States Bureau of Fisheries, and one of America's best known ichthyologists, was recently granted the honorary degree of Doctor of Science by Bowdoin College, on the occasion of the Fiftieth Anniversary of his class at Bowdoin.

Science announces that "a four-story annex to the museum on the estate of WILLIAM K. VANDERBILT, at Northport, Long Island, which houses the largest privately owned marine collection in the world, will be erected in the fall in memory of William Kissam Vanderbilt, Jr."

Professor VLADIMIR TCHERNAVIN is at present engaged at the British Museum on a comparative research on the cranial anatomy of the salmonoid fishes. He is working under a temporary research grant from the Academic Assistance Council, and is hopeful of obtaining a position in America. He has had rather extensive experience in ichthyology.

Fisheries Research News

THE SCHOOL OF FISHERIES has been reestablished, from the Department of Fisheries of the University of Washington. The location of this school, as well as the International Fisheries Commission and a laboratory of the United States Bureau of Fisheries at Seattle, makes that city one of the foremost centers of fisheries research in America. There is an urgent need for associated work of this sort in other sections of the country.

The AMERICAN FISHERIES SOCIETY held its 65th annual meeting at Tulsa, Oklahoma, September 12 and 13. Papers on fisheries research were a main feature of the program. The Society's Committee on the Common and Scientific Names of American Fishes was continued, with the expectation that a standard list of the common names of all important North American food and game fishes, and of other species of considerable economic or natural history importance, would be prepared and recommended for general adoption. Suggestions regarding fish names will be welcomed by the Chairman of the Committee, Carl L. Hubbs. The next meeting of the Society is scheduled for Grand Rapids, Michigan, September 2 to 4, 1936.

Dr. ALBERT S. HAZZARD, has resigned his position in the United States Bureau of Fisheries, under which he was in charge of fisheries research in the Intermountain district, to accept the directorship of the Institute for Fisheries Research, maintained at the University of Michigan by the Michigan Department of Conservation.

Dr. RUSSELL P. HUNTER, of Cornell University, has been appointed Director of the Division of Fish and Game for the State Conservation Department of Vermont.

The recently appointed federal WATER RESOURCES COMMITTEE includes Jay N. Darling, Chief of the Biological Survey, but no one to represent fish interests. Some ideas penetrate slowly.

The AMERICAN WILDLIFE INSTITUTE has been organized to replace the American Game Conference, and to coordinate the efforts of various conservation groups, dealing with fish as well as game. Seth Gordon is Secretary; headquarters are at Washington, D. C.

The MINNESOTA DEPARTMENT OF CONSERVATION is considering the establishment of a fisheries research organization.

"The Classification of Fishes"

STANFORD UNIVERSITY PRESS announces the republication of David Starr Jordan's valuable treatise, *The Classification of Fishes* (1923), a work that classifies all families of fishes, and gives under each a chronological list of all pertinent generic names with page references to the same author's *The Genera of Fishes* (4 parts, 1917 to 1920). The new edition of the Classification, reproduced by offset lithography, is priced $3.50 (paper) or $4.25 (cloth). The republication of *The Genera of Fishes*, also out of print for some time, will be considered by the same press, provided a sufficient demand is made evident.